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TESTING APPARATUS AND MATERIALS.

Attention was called in the issue of the ELECTRICAL REVIEW for December 29 to an interesting article describing methods in use in Germany for testing electrical materials and apparatus. This discussion took up the matter from the viewpoint of the manufacturer, who requires certain grades of material and who must guarantee a certain performance of the apparatus which he puts out.

From time to time attention has been called to the practice adopted by certain large power companies, of purchasing all their materials from rigid specifications and subjecting them to careful analyses and tests to determine whether they come up to the requirements. This practice is increasing, as the results from it are excellent, and it is just not only to the purchaser, but to the selling company as well. Certain companies get all of their supplies in this way. Coal is bought for its fuel value, and not for its dead weight; brass and other alloys are required to contain definite proportions of the various metals of which they are made; copper and iron must come up to certain well-recognized standards; lubricating oil must have a certain lubricating value, and not contain injurious constituents—all of which requirements are clearly stated in the specifications. In fact, every important supply is purchased in the same way and the materials, when delivered, are inspected and analyzed, when necessary, by a chemist retained for the purpose. This practice is giving excellent results, for the purchasing company gets what it wants and knows what it is getting, and the selling company is paid the price which it has set on its own goods. The cost of preparing the specifications, making the inspections and analyses, is trifling compared with the saving effected when the price paid is for the value of the material, and not for a fancy name. But even though there were no material saving, this method of purchasing would still be excellent practice, because it, in a large measure, guarantees the reliability of the articles purchased.

It will be seen from these two points of view that it pays to inspect and test materials which are purchased upon specification; in fact, the success of the business may depend very considerably upon the care with which work of this kind is carried out. With these facts in mind, it is rather strange that the general public, and even a good proportion of operating companies, pay little attention to the testing of materials and apparatus which they purchase upon specification. Much pains and time are spent, and often the services of an outside engineer are wisely secured, in order that these specifications may be drawn up carefully so as to protect the purchasing company and insure that it receives what it is paying for; but when it comes

to carrying out the requirements of the specifications there is less care. Often these requirements are of little value, since no means is adopted to see that they are adhered to. The purchaser seems to think that if he has his agreement down in black and white that he is safe, and makes no attempt to prove that he is getting what he wants. Often certain tests are made in a more or less perfunctory way, not infrequently by inexperienced men. Frequently certain tests are called for, and these are made at the shop where the apparatus is constructed. When it is understood that such tests are to decide whether the apparatus or material comes up to the specifications, and when the purchaser is represented at them, no question should be raised; but it does not follow that when a certain performance is called for after installation that a machine which will come up to this in the shop will do as well after it has been installed. In such cases the purchasing company should make provision for the tests called for in the specification. These may frequently be made by the company's engineers or by an outside man. There are to-day ample facilities for such work, done on either a large or small scale; and even when the articles purchased are bought on the seller's representations, it may be wise to check his statements by subjecting the apparatus to well-recognized tests.

This practice of testing supplies is not a new one. In many industries it has been the custom for generations, and even in certain branches of the electrical industry has been practised for twenty years or more; but it has spread slowly. It is, of course, the scientific method, and it will certainly be more widely used as years go on; but it seems desirable to emphasize the value of the practice from time to time, because there are managers, and even engineers, who hesitate to spend a dollar for any service when they can not show some direct return for this in their reports.

ELECTRIC HAULAGE ON CANALS.

The general public is considerably interested in the improvement of the navigable water-powers and the canals, particularly in the application of electric traction for this purpose. For various reasons the canals in this country have not flourished during the past twenty-five years, one of these reasons being the slowness and expense when using horses. The success of the electric motor in displacing the horse on street railways led to the hope that a similar change might rehabilitate the canals, and thus bring back into active service valuable lines of transportation. Trials of various methods of applying the electric motor to propelling boats in canals have been made from time to time, and, in fact, there are several canals in Europe now depending upon this means for moving the barges. An interesting case is that near Douai, in the northern part of France. The French government maintains here a system of canals and has granted to a private company a franchise for equipping part of the canal for electric traction. This company has not a monopoly of the traffic, so that other means of propulsion, such as horses and tugs, are used, although to a comparatively small extent.

The length of canal already equipped in this way is about thirty-six miles. Part of this equipment is recent. The earlier system employed a trackless trolley, consisting of a three-wheel locomotive drawing its power from an overhead conductor and running along the common tow-path. While this method seems to have given satisfaction, a part of the canal has recently been equipped with a light railroad laid on the side of the tow-path, over which more locomotives run, towing the barges. There is but a single track, so that these locomotives ply back and forth over certain sections of the line, exchanging barges when they meet. While more expensive than the old tricycle, since it calls for a line of rails, the new system is much better than the old for it reduces the power required to move the tractor to about sixteen per cent of that required by the tricycle. The locomotive consumes, running alone, only two kilowatts, and the tricycle thirteen. The locomotive is simple in design, consisting merely of a single four-wheel truck, on which are mounted two twenty-horse-power motors, and over which is built a light iron cab. The controllers are of the ordinary street-car type. It is said that the track cost about $6,000 a mile, and each locomotive cost about $1,600. The maximum charge allowed is thirteen cents a ton mile upstream, and about eleven cents downstream.

This canal is comparatively small, having an average width of about sixty-three feet and a depth of seven and one-half feet. The barges have a capacity of 290 tons, and the allowable speed is only three kilometres an hour, or about 1.9 miles. The system is popular with the barge owners, as less than ten per cent of the traffic is moved by other means through the electrical section of the canal; and as the company desires to extend its system, eventually equipping about forty-seven miles of canal, evidently it has proved profitable from its standpoint. Under conditions where a greater speed were possible undoubtedly a better showing would be made, as the conditions at present are more favorable to horse traction. Moreover, where larger barges are possible a still better showing should be made. If our canal systems, which to-day have fallen almost into disuse, are to be restored, it would seem that electric traction is to play an important part in this work.

THE ALUMINUM CELL AS A LIGHTNING ARRESTER.

The peculiar properties of aluminum when used as electrodes in certain solutions have been utilized for various purposes, use being made of the fact that a current will pass readily to aluminum from a solution, but not in the other direction, because oxidation apparently takes place and covers the aluminum with an insulating film.

A new use of this insulating property of aluminum is discussed in the paper read at the recent meeting of the American Institute of Electrical Engineers. Although the coating formed on the aluminum in various solutions is a good insulator, it has not a very high dielectric strength. With many solutions it breaks down at about 120 volts. There are others, however, which enable it to stand several hundred volts. The hydrocarbons of the aromatic series are particularly useful, as has been pointed out by Pollak. But if the potential be carried higher than the

limiting value, the surface film breaks down, the opposing resistance disappears, and a path of low resistance is formed. It is this property that is utilized in constructing a lightning arrester. As many pairs of plates as may be required are placed in series, but the device may be constructed so that, while presenting good insulation for the normal potential of the circuit, a comparatively slight increase will be sufficient to cause it to give way. For example, a group of plates may be arranged to resist perfectly 10,000 volts, yet at 12,500 volts will give way.

If further experience with the aluminum arrester proves it capable of all that is expected of it, it will be a valuable addition to lightning protective devices. It is probable that those disadvantages which seem to have retarded the use of the rectifier and condenser will not be so serious here, for lightning arresters placed either at the main generating station or at substations are taken care of. It is only when a machine is placed in the hands of some less responsible person that it suffers from lack of attention. The electrolyte must be renewed and the cell kept clean—features which are very apt to be neglected by those who do not fully appreciate their necessity. It is possible that these features may be sufficiently disadvantageous to prevent the use of the aluminum discharger on transmission lines, particularly because such a device must naturally be placed under cover, and well-protected from the weather. But at those places on the system where employés are constantly in attendance, or where inspections are frequently made, the necessity for a certain amount of attention may be an advantage rather than a disadvantage. These inspections will ensure that the protective apparatus is always kept in first-class order.

It remains to be seen how far this method of protection will be carried. Mr. Jackson has used it rather satisfactorily up to 40,000 volts, and from the character of the device there seems to be no reason why it should not be equally as satisfactory for 50,000 or 60,000.

A CONSTANT-CURRENT DYNAMO.

Some time ago a new type of constant-current generator was brought out by Dr. E. Rosenberg, as part of a system of train lighting. This generator was self-regulating to a large extent throughout a comparatively wide range of speed, and was thus suitable for a system of train lighting in which the power was derived from the car axle, the speed of which, of course, varies continually. As this type of generator seemed to give such good results for train lighting, the inventor thinks that it may be used possibly, in modified form, for other services in which a constant current is desirable or necessary, and he has described recently a modified form of generator intended for such purposes.

The chief feature of the Rosenberg dynamo lies in the method of regulation. Assuming a two-pole field, there are two sets of brushes. That pair in the usual position—that is to say, midway between the pole tips—is short-circuited; while there is another pair placed midway under the poles. In the earlier type of machine the field was separately excited. As the armature revolved the electromotive force set up caused a current to flow between the short-circuited brushes. This armature current set up a magnetic field at right angles to the normal field, thus shifting the distribution of the flux. That pair of brushes under the middles of the poles will show no difference of potential while the magnetic field set is up by the field winding alone; but as soon as the armature reaction distorts the field a difference of potential appears between them, and a current may be drawn off. These brushes supply the external circuit and are used for charging the car batteries and operating the lamps. The regulation depends upon the fact that the greater the speed of the armature, the larger the current flowing between short-circuited brushes, and the greater the demagnetizing effect of the reaction. The resultant magnetic field thus decreases as the speed increases, which gives the generator a drooping characteristic similar to those of the old series arc-lighting dynamos. To improve commutation a wide slot is cut in each pole piece directly over the brush so as to give at this point a suitable commutating field.

In the newer design Dr. Rosenberg suggests that the generator may be series-wound, and thus become self-exciting. A winding of this kind gives a drooping characteristic when the dynamo is driven at constant speed, but since the field current will increase with the load there is a tendency for the current not to be maintained strictly constant. There is, however, a marked tendency toward regulation at constant current, so that the machine may prove useful where this is desirable. Such generators of large current outputs would be suitable for running searchlights and for electric welding. At the moment of starting, with the electrodes in short-circuit, the current would be little greater than the normal, but this, in many cases, would be beneficial rather than detrimental. This type of machine is suitable for series-arc lighting or other such purposes.

A method of regulation which depends upon a weakening of the field due to the armature reaction can only be secured in a machine which is relatively heavy, and the method used by Rosenberg probably produces a machine in which the output per pound is relatively small. Not only must the armature be powerful, so as to overpower the field, but it must be designed so that the armature will not be overloaded by the current exchange between the short-circuited brushes. Moreover, the machine must be designed so as to utilize to the best advantage the effect thus produced. In normal machines, with a considerable gap between pole tips, this would be an inefficient method of controlling the field, because of the high reluctance of the magnetic circuit. It must be remembered, however, that the total load on the armature will not be the sum of this demagnetizing current and the load current, because, while the two currents would be added together throughout part of their common paths, they would be subtracted in the other. It will be interesting to have some experimental results given of this machine which would show the efficiency and the output per pound, as well as the amount of inherent regulation.

Electrical Progress During 1906.

IN SUMMING UP the progress made in the electrical industries in the year just closed there is but little of a striking nature to record. Events which have taken place within twelve months are too recent to be viewed in the proper perspective. The full significance of certain happenings can not yet be determined, while other events, which at the time they occurred attracted considerable attention, seem now of less importance. This condition confronts any one attempting to outline recent industrial progress, for while he may be able to point out the general condition to-day and contrast it with what it was a year ago, and to indicate what particular features seem the most interesting in each branch, the nearness of these events is apt to exaggerate the details and partially mask that growth which is of true significance. Another difficulty in any such review of industrial development is the setting of exact dates. Few inventions are merely the result of inspiration: they are generally of slow and painful growth; and, while a generation hence may be able to look back and say that such and such a year was significant on account of a certain discovery or invention, happenings not so far back are viewed more as steps in a general advance than as departures along a new path.

The year just closed was noteworthy, so far as the electrical industries are concerned, for prosperous business conditions. On all sides shops were busy turning out orders, and, in fact, found it difficult to fill all those which they secured. The amount of business done was larger than in previous years, and not only was the growth along the old paths, but there was a branching out into new directions. Electrical methods are spreading rapidly into all industries; they are fast becoming the means by which industrial processes are carried out.

To run over briefly the various branches into which the electrical industry is somewhat arbitrarily divided, they are taken up in detail in special contributions which follow, it is natural to mention first the telegraph. There has been no great change in this field so far as the older methods are concerned. While the telephone is becoming more and more a competitor, the telegraph companies in this country can show a healthy increase in business. No change has been made, of particular importance, in the methods of telegraphy, but the machine systems, which have been tested more fully during the year, in some cases seem to have given satisfaction. The introduction of printing telegraphs is, however, taking place very slowly. The putting into service of a number of single-phase, high-voltage railway systems proved that these are detrimental to neighboring telegraph and telephone wires, and brought this forward as an important problem now confronting the telegraph engineer.

The radio-telegraph systems have grown encouragingly, but the chief use is still between ship and ship, and between ship and shore. Most of the progress during the year was in developing details and devising new and improved appliances. One of the most important of these—at least, if it comes up to the promise held out—is the devising of means for producing continuous waves of high frequency. Valdemar Poulsen has adapted the singing arc to this purpose, but even this application is not new, although the first successful use of it was made during the year. Others have been working in the same direction, with some success.

An important event in the radio-telegraph world was the Berlin conference, held during the fall. All but one or two of the civilized nations sent delegates to this, and a set of rules was drawn up which will tend to increase the facilities for the exchange of messages.

In the telephone world the most striking feature was the increase in the use of the telephone, which has been maintained and even accelerated. This is true both of city and country. The large companies are pressed to install all the instruments that are called for. It has been estimated that there are in this country nearly 7,000,000 telephone instruments now in use. There has not been any particularly noteworthy change in the apparatus used, but a goodly number of telephone engineers have been devoting their attention to improving the apparatus. More attention is being given to the automatic systems to-day than formerly, but one can not look for early condemnation of the entire manual system. An intermediate step will undoubtedly be made should the automatic system eventually prove to be the better.

Two systems of wireless telephony were described and tested during the year, by Ruhmer and Slaby, respectively. The latter succeeded in conversing over a distance of twenty miles or more.

The electric lighting industry has had a most prosperous year. The feature in this work which attracted the greatest amount of attention was the endeavor to increase the use of electric current. The companies individually made greater efforts to increase their sales, and a general plan of cooperative action was put into force. The increase was considerable, but it is yet impossible to state how much of this was due to the prosperous condition of the country, and how much to more energetic solicitation. No important developments occurred in power-house practice, but the interest in new and improved forms of illuminants was unabated during the year, and was even increased by the production of several new lamps. One, the tungsten lamp, is particularly noteworthy, not only on account of its high efficiency and promise of good performance, but because of its method of preparation. The filaments are pressed from a paste produced by reducing the metal to the colloidal condition. Another, called the "Helion," is formed by depositing silicon on a carbon filament. Its efficiency is said to be one watt per candle, and the life is long. A field of work allied to electric lighting is that of illuminating engineering. This received an unusual amount of attention during the year, following the formation of a society for this purpose.

Electric traction may be taken up as the next division chronologically, though, of course, the electrochemical industries date back to the production of primary batteries and the use of electro-plating. The latter industry, however, attracted but little general attention until later. The electric traction has grown rapidly since it first demonstrated its reliability. It has always been one of the most important fields of electrical application, and has attracted the greatest amount of public attention. It has now reached a stage where it becomes necessary to divide its field of application, although it is impossible to draw a hard-and-fast line. On the one side is the street railway system. On the other is the introduction of electric traction on steam railroads. Between the two divisions we have those city lines serving the purpose of street railways, but

operated as a railroad. These are the elevated lines and the subways, on which trains of several cars are run. On the street railway branch the equipments have not changed, except where the individual switch system is being used in place of the old drum controller. The advantage is the greater reliability and ease of repair, and the ability to run cars in trains, as the system is adapted to multiple-unit control. A number of roads have been equipped with the single-phase, alternating-current system, but we can record here nothing of development or improvement.

In the railway field an event of importance was the starting of electric trains on the New York Central electric zone at New York city. This was done in December, a few trains being put on and run in between the regular steam trains. Other steam roads are busy equipping certain sections of their systems electrically, evidently with the idea of trying-out the new method with a view of introducing it on those sections where local conditions make the change desirable.

Another significant feature of the year was the drawing together of independent electric lines in the Middle West, whereby traffic arrangements were brought about. This will facilitate travel on these lines and make the roads more dangerous as competitors of the steam roads. On the other hand, certain steam roads sought to protect themselves against such competition by acquiring the electric lines in their territory.

It is usual to consider hydroelectrical development and electrical transmission together, as they are mutually dependent. The utilization of our water powers has gone on steadily and surely. The tendency is toward larger generating units because of their economy. Considerable interest has been shown in the hydroelectric work going on and proposed at Niagara Falls, anxiety being expressed in some quarters lest the beauty of the falls be damaged. Practice in high-tension transmission, which as yet does not go above 60,000 volts, shows a tendency toward standardization for that pressure. All electrical transmission lines, for whatever purpose, are now built more substantially than before and auxiliary devices are designed to withstand more severe service.

An interesting announcement recently made was the organization of a large company to utilize the waste coal heaps at the mines in Pennsylvania by means of electric generating stations there and transmitting the power to distant cities.

In the electrochemical and electrometallurgical industries much progress has been made in developing methods, but descriptions of these are not usually made public: they are treated as trade secrets. The trend of work may be followed to some degree by watching the patents granted. It appears that most of these industries are in a prosperous condition, since enlargements are common.

Investigation is going on rapidly with the high temperatures produced in the electric furnace, but although encouraging reports of its use for producing iron and steel are made, it has not yet—in this country, at least—been applied for this purpose. New materials are continually being produced which were formerly chemical curiosities. The difficulty is that, in general, there is no demand for the new products, although certain of them possess properties of much importance.

The primary battery is in about the same condition it was a year ago, while with respect to the storage battery no far-reaching change has been made, although much work has been done in improving the details of the battery itself and its auxiliary appliances.

Although leaving the electric theory until the last, it might properly be given a leading position. A large part of the energy devoted to physical research is confined to electrical or allied fields. The radioactive phenomena have been followed enthusiastically, but probably with not as much energy as before. This field is being left to a small number of men who have done distinguished work in it. A feature here was the suggestion that actinium might prove to be an intermediate product in the production of radium from uranium, which is supposed to be the parent element.

The electron theory, proposed by Lorentz, has proved valuable in predicting phenomena, and this, in addition to the clear conception it gives of electrical action, has brought it into popularity. It is now becoming common for investigators to explain their results in terms of this theory.

Developments in Electric Lamps During 1906.

By Dr. Clayton H. Sharp.

THE year just past has been distinguished by almost revolutionary progress in the field of electric lighting.

The year 1905 saw the introduction of the graphitized or so-called "metallized" carbon filament lamp, which promised considerable increase in the efficiency of electric lighting. The same year brought forth the tantalum lamp, which was even more efficient than the "metallized" carbon lamp. The achievement of 1906 is even greater, for its product, the tungsten lamp, far outstrips in efficiency all the others.

It may never be possible to point to any one individual as the "inventor" of the tungsten lamp. Various investigators searching among the materials which seem to have possibilities for the production of incandescent lamps worked with this metal. Its nature is such that its reduction to filament form presented a problem of unusual difficulty, but this problem seems to have been solved in a variety of ways.

Dr. Kuzel has proposed to make a colloidal solution of the tungsten and to squirt filaments of the finely divided metal so formed, afterwards changing the metal from the colloidal to the crystalline state by the passage of a current through it. Dr. Just and Hanaman have used a substitution method. They start with a very fine carbon filament which they heat in an atmosphere of chloride of tungsten and hydrogen. Under proper conditions a carbide of tungsten is formed, from which the carbon can be removed by an oxidizing process. The process worked out by Dr. Auer von Welsbach for making osmium filaments has been very successfully applied with certain modifications to the production of tungsten filaments. In this process the tungsten is mixed with an organic binder and squirted into filaments. The carbon is removed by oxidization in an atmosphere of steam and hydrogen, the hydrogen serving to reduce any tungsten which may become oxidized. In this country tungsten filaments have been made by John A. Heany and by the General Electric Company. The processes by which these filaments are made are said to differ radically from each other and from those in use abroad.

These lamps, even in their earliest experimental stages, showed most remark-

able properties. At present they have progressed to the point where they are actually on the market in Germany and Austria and are promised in commercial quantities in this country in the near future. The tungsten filament being a pure metal, exhibits characteristics quite different from those of the carbon filament. One of the most prominent of these is the inherent current regulation which this filament possesses, due to its positive temperature coefficient. The result of this is that with a five per cent increase in the voltage above normal, the candle-power of the tungsten lamp increases twenty per cent and the watts per candle decrease ten per cent as against thirty per cent and fifteen per cent for the carbon filament. In other words, the change in candle-power with change in voltage is only two-thirds as great as with the carbon lamp. This property must result in a more satisfactory service to users of the light.

If voltage variations are carried to extremes it is found that the tungsten filament becomes luminous with voltages so low that the carbon filament appears entirely dark. At the other extreme, if burned for a short time on double the normal voltage, the tungsten lamp suffers no apparent injury, while the carbon filament is destroyed in a few seconds.

The life curve of candle-power of the tungsten lamp differs also materially from that of the carbon lamp. The latter, after an initial rise, declines steadily until the end, due to the disintegration of the filament and the blackening of the bulb. The tungsten lamp, on the other hand, tends to maintain its candle-power with but little decrease until the end of its life. Its "smashing point" comes, in general, at the end of its life and not sooner. The filament when ruptured during burning may sometimes be repaired by bringing the parts together, in which case the lamp goes on burning with increased candle-power.

The color of the light from the tungsten lamp is of a very agreeable white, which, in itself, constitutes no inconsiderable improvement.

At present the tungsten lamp suffers under several practical disadvantages. On account of the high conductivity of the material the filaments of lamps for 110 volts need to be very long and fine if the candle-power is not to be excessive. This necessitates a very special method of mounting and anchoring them, which is necessarily more expensive than that employed with the carbon lamp. In spite of the extreme degree of tenuity to which it is possible to go in the production of these filaments it has been as yet found impracticable to produce lamps for 110 volts for candle-powers much less than twenty-five or thirty. Practically it will very likely be necessary to go somewhat higher in candle-power in commercial production. It follows, therefore, either that the tungsten lamps will be produced in high candle-power units, or if made for low candle-power, the voltage of the circuit on which they are burned must be reduced. The tungsten filaments have also the serious disadvantage of being very fragile so that these lamps need to be handled with very great care.

The efficiency of the tungsten lamp will be practically much higher than that of the carbon lamp. At 1.25 watts per mean horizontal candle-power, good tungsten lamps have a much longer life than carbon lamps at 3.1 watts per candle. Experiments have indicated that at one watt per candle the tungsten lamps may give satisfactory results. The relation between the watts per candle and the life of these lamps is not yet definitely known, so that it is at present impossible to say just what the operating economy of these lamps will be when they are produced commercially in large quantities and when such faults as develop have been eliminated.

The effect of the introduction of lamps of such increased economy can not but be profound. The tungsten lamp at one leap has surpassed all the other more common forms of electric illuminants in efficiency. Not only the carbon incandescent lamp but the enclosed carbon arc lamp is outdone. The way is opened for a radical change in the lighting situation. Tungsten lamps can be made for series burning on street lighting circuits which will probably surpass the street arc lamps in efficiency and cost of maintenance, and which give at the same time that subdivision of the street lights into small units which is so desirable from an illumination point of view. For interior lighting the tungsten lamp is likely to do the service of increasing the use of indirect illumination, which in itself is a very desirable result. The introduction of an illuminant which costs less for current per candle-power produced will undoubtedly raise the standard of illumination everywhere. The cost of lighting with these lamps will come so near to the cost of incandescent gas mantle lighting that in all situations where convenience, cleanliness, safety and decorative effect have any weight at all, the preference must be for electric rather than gas lighting. The significance of this to the further development of the electric lighting industry is most important.

Just at the very close of the year comes the announcement of another development in incandescent lamps which is equally startling. Messrs. Parker and Clarke, of Columbia University, have presented to the Physical Society a lamp with a filament that is said to be composed of a mixture of carbon and silicon and to which they have given the name "Helion" lamp. The outer surface of this filament may be of pure silicon. The filament is prepared by flashing a fine carbon filament in an atmosphere containing silicon. For these lamps an economy of one watt per candle and a possible life of 1,200 hours are claimed. The filaments are evidently of high specific resistance so that they are no longer than carbon filaments and can be mounted in their bulbs in the same way. If the claims for this lamp can be substantiated, and no insuperable difficulties are met in its commercial production, it constitutes an improvement even more important than that represented by the tungsten lamp.

The past year has seen great progress in the commercial utilization of other new illuminants. "Metallized" carbon and tantalum incandescent lamps have become a regular commercial product and are being used in practice. The mercury arc has found a continually increasing application and has become a factor in the situation. Flaming arc lamps have been employed in increasing numbers, chiefly for advertising purposes. The indications are, however, that a more extended field will be found for this very powerful and efficient illuminant. In Berlin flaming arcs are being used for illuminating the Potsdammer Platz and a space on one side of the Brandenburger Tor with splendid effect. Magnetite arc lamps have been installed on series circuits for street lighting in a number of cities, and are thereby raising the standard of efficiency in this field. The ordinary lighting business with the older forms of illuminants has increased enormously and so rapidly that in many cases difficulty has been experienced in keeping pace with the demand.

As an evidence of the attention which is being given to illumination and its scientific and practical problems, the formation of the Illuminating Engineering Society may be noted. This society, which was formed during the early months of 1906, has had an unexpectedly large growth, its membership at the end of the year being about 900.

The intense activity of the past year augurs well for the future. After the readjustments necessitated by the new conditions introduced by high-efficiency illuminants have been made, there is every prospect that the developments of electric lighting will be even more astonishingly rapid than they have been in the past.

A New System of Telegraphy.

A new system of telegraphy has been invented by Stephen D. Field, the well-known telegraph engineer. Mr. Field has devoted many years to the study of telegraph problems and has contributed various notable inventions, which are now in general use. The new system is a modification of the Morse, and is, the inventor believes, the final step in its development. In the Morse system of transmission the relays at each station are operated directly by the current from a battery which flows through the line when a key is closed. The strength of the current at each relay, and hence the sharpness of the signals, depend, of course, upon the voltage employed and the electrical constants of the line. But they also depend upon the goodness of the line insulation, and in bad weather so much leakage may take place that it will be impossible to obtain

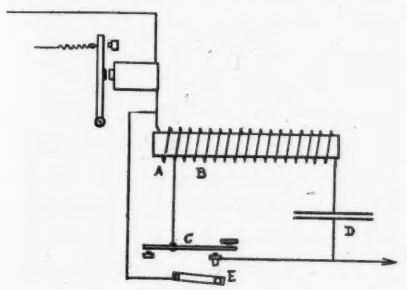


Diagram of Relay, Coil and Key Connections

sharp signals; the relays respond slowly and transmission is tedious and difficult. Mr. Field's new system is designed to overcome this trouble and render the line independent of the weather and other factors having a similar influence. It has given beautiful results on an artificial line purposely made as bad as possible. The following description of the new system was prepared by Mr. Field.

In the new system of Morse transmission advantage is taken of the idle time occupied by the spaces in the alphabet to store up, at each station where the transmission key is being manipulated, a small amount of energy from the line battery and relay discharge currents, said energy being utilized in the formation of the next succeeding dot or dash. The result is accomplished by means of an induction coil and condenser arranged to bridge the signal key.

When the key is open a condenser is charged through a heavy impedance which is formed by the primary of an induction coil, the secondary of which is included in the line circuit. On closure of the key the energy stored in the condenser acts inductively upon the primary winding, setting up currents in a direction to assist the line battery in its work. As a result of this arrangement all the relays in the circuit respond firmly and quickly to the key movements, no matter how "high" their adjustment, and it becomes possible to work circuits at full speed during stormy weather, which, under old conditions, could only be operated very slowly or not at all.

The diagram, illustrating one form of the arrangement, is as follows:

Opening the key C a current from the line has a tendency to charge the condenser; it is met, however, by the immense impedance of the coil B, which should equal the drag of all the other apparatus in the circuit; a prompt break of the line current is thereby assured. On closure of the key the condenser discharge, in circulating through the convolutions of coil B, induces currents in coil A of the proper direction to assist momentarily the line current.

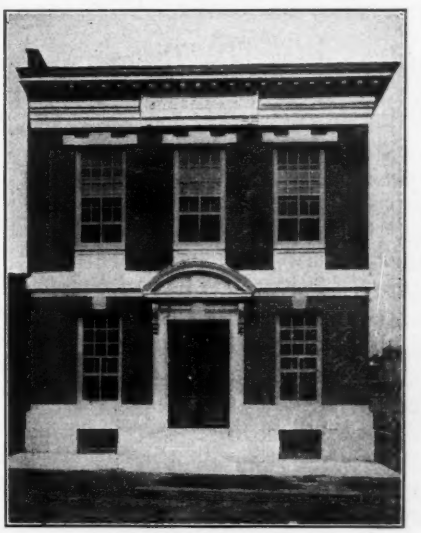
By this means a phantom line battery is provided at every way station on the line, resulting in greatly increased working margin on the whole circuit. When used on short circuits the condenser B is sometimes omitted, the magnetic charge acquired by coil B having been found sufficient. When the key is at rest the switch E shunts the whole arrangement from the circuit.

Many modifications of this arrangement have been devised and completed, such, for instance, as making the relay act as an inductorium, using extra windings on supplemental core extensions for the purpose; but in universal application the arrangement illustrated will probably be found most suitable, as it involves no change in existing apparatus and adds nothing liable to go wrong to the circuit.

The New Exchange of the Delaware & Atlantic Telegraph and Telephone Company at Chester, Pa.

The city of Chester, Pa., has at the present time a population of 38,000. Its geographical position is about twelve miles southwest of the City Hall, Philadelphia, but the distance between the borders of the two cities is less than five miles. In the past six years the population of Chester has increased eleven per cent while the Bell telephone growth has been 551 per cent. In that city there are now 660 lines accommodating 1375 Bell telephones operated from one of the finest exchanges in any city of the same size in the country.

Three years ago the Delaware & Atlantic (Bell) Telegraph and Telephone Company found that if the present rate of increase in applications for service continued, new quarters for all local departments must be provided. Property was at once purchased and drawings for the new building begun. On Thursday, November 8, 1906, the new central office building was formally opened to the public. Invitations had been sent to hundreds of representative subscribers throughout the district and also to many others interested. Probably eight hundred responded and were shown every part of the plant from the cables in the basement to the provision for ventilation. Five plant representatives and more than that number of contract men with ushers' badges were present to assist in receiving the visitors.



The Chester (Pa.) Exchange of the Delaware & Atlantic Telephone Company.

The building is of Colonial brick trimmed with white marble and the roof is of green slate. The completeness of the interior finishing and equipment will compare with Chester's best buildings. On the first floor are the offices of the district manager, which are finished in white tiling and quartered oak. In the rear are the offices of the district engineer and the main distributing-frame room. On the second floor are the switchboard and the operators' retiring room. The switchboard is a five-section one containing positions for nine local operators, two toll, two incoming trunk and one trouble operator. Its present capacity is for 5,000 lines and its cost was $100,000. Sufficient space has been provided to enlarge to 9,000 lines, which would increase the cost to $200,000.

The increase in telephone subscribers in

and near Philadelphia during the past few years has been the cause of many new central offices being opened and others being enlarged. The company's engineers in providing for future development have been kept busy with studies of traffic gains. It is hardly necessary to state that the company expects this gain to increase and will continue to open new offices and increase facilities throughout the territory which it controls.

The details of the cut-over from the old switchboard at Third and Market streets to the new one on Fifth street are here given as a matter of interest to the readers of the ELECTRICAL REVIEW.

1. Cable is pulled and tapped on the main cable leads of each exchange.

2. From the new switchboard the circuits in the above-mentioned cable are tested direct to each subscriber's station. All trouble here is removed.

3. About one week is required to test out the multiple and answering jacks of the new exchange and to remove all trouble.

4. Another week is then occupied in running cross connections for subscribers' lines and trunks and calling circuits, both on the main and intermediate frames.

5. The tags are then so placed in the relays that when the cut-over takes place the tags may be instantly removed in groups.

6. The heat coils in the old exchange are joined so that they may be removed simultaneously with the removal of the tags in the new exchange. In this way one exchange is cut out of service and the other is cut in service at the same moment.

7. Immediately after the cut-over the testing table makes a test of every line by means of the voltmeter, an instrument arranged to show whether any line is clear of foreign wires, grounded or open.

8. On the following morning the operating department makes a ringing test of each subscriber's line to insure perfect transmission in the transfer from the old to the new switchboard. Any trouble is first looked for in the exchange, but if not found a man is immediately sent to the subscriber's station.

At the actual time of the cut-over conversations then going on are interrupted. The operator then "comes in" and asks that the number called be repeated. She handles each local call so interrupted as a new call.

An exchange of this size makes an unlimited local service plan equitable. The only loss in the interruption is, therefore, one of time. The call may be immediately repeated by the subscriber and put through without delay.

Recent cut-overs have been very successfully made at Jenkintown and Sharon Hill, Pa., and at Belmont, Lombard and Chestnut Hill central offices in Philadelphia.

The time chosen for such cut-over is either during the evening after the traffic of the day has slackened or on Sunday morning when the telephone business is usually very light. Two men at the testing table, one at the switchboard, one at the main distributing frame and eight other helpers are probably all that are required to make this almost instantaneous change. Of course, each board will have a number of operators to handle the business before and after the work is completed.

Usually at the time of cut-overs many of the subscribers' telephone numbers are changed for various reasons, but the Chester cut-over will be made with practically no changes and subscribers will have their old numbers at the new switchboard.

Chester is benefiting materially by this change. The time on both incoming and outgoing Philadelphia calls has been greatly decreased because such calls are now handled by direct trunking circuits to six of Philadelphia's central exchanges. They were previously passed through the toll office in Philadelphia and from there distributed to the various local offices. Taking the change from the subscribers' viewpoint, when calling any of the above-named company's offices from Chester or *vice versa,* they will not have to hang up their receivers and wait to be notified that the called subscriber is on the line. The same almost instantaneous method of passing calls will apply to calls from Chester to Lansdowne, Ridley Park and Sharon Hill, and *vice versa.*

The new underground trunks between Philadelphia and Wilmington which are looped in at Chester were cut in service on November 5. Since that time a large part of the messages between Chester and the other two points have been passed underground. As a direct result of quicker and better service the Philadelphia-Chester business has increased a full third since this change was made, showing the subscribers' appreciation of quicker out-of-town service. Improved local service has been one of the main causes of the need for this new central office.

The location for this building was also well chosen. It is on Fifth street—a street with trolley service—and opposite two of the largest office buildings in the city. The Post Office grounds adjoin the property of the telephone company.

The interest of visitors was especially noticeable when they were shown the provision made by the company for the operators' comfort. An ice-box for keeping milk; a special "indirect radiation" heating system, careful provision for perfect ventilation, a matron on duty for the comfort of the operators and to serve milk and coffee without charge, and numerous other provisions were seen by many subscribers for the first time.

The Northern Westchester Securities Company.

The Northern Westchester Securities Company has been incorporated in the state of Connecticut for the purpose of acquiring from time to time the stock and other securities of public service corporations and other companies, including real estate development companies and particularly the traction, gas and electric light, heat and power companies operating in the northern part of Westchester county, New York, and also for the purpose of advancing to such companies in which the Northern Westchester Securities Company may be at any time interested, such moneys as may be necessary for alterations, extensions and improvements.

The company has already acquired the common stock of the Peekskill Railroad and Lighting Company, which is pledged with the Knickerbocker Trust Company as security for the payment of the thirty-year collateral trust five per cent gold bonds issued by the Northern Westchester Securities Company. The amount of these bonds issued at this time is about $120,000.

Gifts for the Land and Building Fund of the American Institute of Electrical Engineers.

Samuel Insull, president of the Chicago Edison Company, and C. L. Edgar, president of the Boston Edison Company, have each contributed $1,000 toward the land and building fund of the American Institute of Electrical Engineers. Both of these gentlemen are members of the advisory committee of the land and building fund. F. W. Roebling, of the John A. Roebling's Sons Company, Trenton, N. J., a member of the Institute since 1887, has also contributed the sum of $1,000 to this fund.

Electric Railroading in 1906.

By Dr. Louis Bell.

FROM the statistical standpoint one might make a brave showing this year, for building has been active, consolidations and extensions have been rampant and many roads have taken advantage of a season of exceptionally good business to undertake extensive rehabilitation. Manufacturers in nearly every line have been overloaded with work, the wages of employés have been raised in many places, and in general business has been booming. Activity, however, does not necessarily imply advance in methods or their applications, and for some years past the improvements in the technique of electric railroading have been mostly in detail. To substitute a ninety-horse-power motor for an eighty-horse-power motor and a Type Z controller for a Type Y is, to be sure, improvement, assuming the former to be on the whole better than the latter, yet it may really delay progress if the thing really needed was a radically new 100-horse-power outfit instead of a makeshift. It is, therefore, very hard to evaluate the importance of such changes in their bearing upon the general art. In larger matters the year has been one of hopes deferred, save for the initiation of electric traction on the terminal division of the New York Central, which has made notable the closing weeks of the year. The promised alternating-current terminal work of the New York, New Haven & Hartford Railroad still remains a promise, with, however, good hopes of a near realization. That road, however, can hardly be accused of inactivity in electric railway matters, since it has recently reduced to tabloid form and swallowed the trolley interests of two states. Aside from the two very notable movements toward the larger electric traction just noted, perhaps the most striking works of the year have been the experiments of the Boston Elevated with gas-engine generating stations, and the unsensational but very important unification going on among the fine interurban systems of the Middle West.

The gas-engine stations of the Boston system have been considerably discussed. They are auxiliary stations, following the general distribution practice of the elevated system, and neither of them is large, the Somerville plant being of 700 kilowatt capacity, the Medford station of 975. They have been in very competent hands and in the matter of economy have done well. The smaller of the two plants has been in regular use for more than six months, for the most part sixteen hours per day. With an engine load-factor of between seventy and seventy-five per cent, not abnormally high for an auxiliary station upon this well-organized system, it has shown an average duty of less than 1.5 pounds of coal per kilowatt-hour, falling to 1.31 pounds on a thirty days' test with Pocahontas coal. The demand for water proved to be less than one-third that of a compound condensing steam plant of similar output, and it goes without saying that the fuel consumption is better than in any steam plant on similar service, or in fact, under any working conditions. It is in fact little over half the normal figure for a good compound condensing plant, although for a gas engine the performance is not extraordinarily good as compared with some test results. Comparisons between gas engines and steam engines are rendered difficult by the absence in the former of anything corresponding to steam consumption, so that the boiler plant has to be considered. From a general operative standpoint the plant seems to have been a success so far as is yet reported. The larger station, which is equipped with two-cycle engines, seems not yet to be fairly in running shape, and no definitive results are yet obtainable from it. In an official letter explaining why power for heating the street cars has been at times lacking, this plant was practically made a scapegoat for the lack of capacity, although not mentioned by name. It will be interesting to see whether the two-cycle engine makes good upon this large scale. In passing it is mere justice to say that there are a good many people, including the writer, who are glad to find cars at a comfortably cool temperature, and would be sorry to have the old days of overheating back again upon any terms.

The Boston experiment can hardly yet be considered conclusive as regards the general use of gas engines for electric railway service. It has been satisfactory enough, however, to warrant similar trials elsewhere, especially in case of long roads. A gas-engine plant able to put power upon the line on the fuel expenditure found in Somerville is a pretty serious competitor of any transmission proposition from a steam-driven central station involving the use of substations with rotaries. Each kilowatt-hour delivered to the trolley wire *via* such a transmission implies ordinarily the consumption of four to five pounds of coal at the central station, and the up-keep of the high-voltage system would go very far to offset the increased labor at the gas-engine station, to say nothing of the greater reliability of the independent plant. The dubious point in such a comparison arises when one considers the use of high-voltage alternating current on the trolley wires. During the year there have been several minor installations with alternating-current motors, and they seem to have been upon the whole successful and encouraging. This at least can be said regarding them, that the criticisms of them are couched in vague terms, and that there is no consistent allegation of any particular weak point. Objections generally simmer down to the intimation that alternating-current roads are a little queer and do not use "standard" (*i. e.*, direct-current) equipment. Under such circumstances they can very well be left to work out their own salvation. There have been various threats of high-voltage, direct-current systems, none of them of very deadly character, and perhaps not to be taken too seriously. In this connection the high-voltage, direct-current system of the Wiener Stadtbahn deserves some little comment. In this case, confined as yet to a single short branch, the distribution is on the three-wire system with the track as neutral and 3,000 volts between the outside wires. Each locomotive has four 750-volt motors geared in pairs working on the same axle. Each pair acts as a unit taking current from its own side of the neutral, so that the system is automatically in approximate balance on each locomotive. A similar scheme of self-contained, three-wire units is worked with one motor on a side, at more moderate voltage, on several Continental lines. It would be indeed a curious turn of Fortune's wheel if the general use of heavy and powerful motor cars with the necessity for multiple motor equipments should bring back into favor the three-wire system which had been cast out on account of inordinate difficulties in preserving balance. The system, in its present form, certainly can not be turned down upon the face of the facts, and ought to receive respectful consideration.

In the same connection should be mentioned the evolution of the Ward-Leonard alternating-current-direct-current locomo-

tive at the hands of the Oerlikon Company, and another Continental experiment in the same line, using the permutator as the source of direct current for the motors. This very ingenious device deserves more notice on this side of the water than it has yet received. Practically a synchronous commutating transformer with revolving brushes, it is capable of being worked with a very high primary voltage and combines light weight, comparable with that of an induction motor of similar capacity, with very high efficiency. It seems, therefore, especially well suited to use on an electric locomotive, and in such a situation the revolving brushes can receive adequate attention, an attendant being always at hand. The problem of heavy electric traction is therefore being approached from several different directions, any one of which in the absence of the others would prove practicable for a successful attack. The richness of resource is really embarrassing and it may take considerable time to settle upon the most advantageous method for general purposes. All the propositions involve high voltage on the working conductor, which is the *sine qua non* in serious work on heavy electric traction. It is matter of regret that the radical improvements in method were delayed just long enough to prevent their use in the New York Central case. It is a pity to see the first large work of such kind carried out, however skilfully, at a working voltage which must be abandoned for large work in the very near future.

Recurring now to the situation in the Middle West the readers of the ELECTRICAL REVIEW are doubtless well acquainted with the general features of the network of interurban lines that overspreads Ohio and Indiana and portions of neighboring states. The situation is a most interesting one. Built singly or in groups, the interurban system has, especially during the year just past, been welded into a fairly homogeneous mass. Its parts may be related by common ownership, common interests, or neighborly comity through traffic and fare agreements, but the final result has been a most important and valuable addition to the means of rapid transit in a singularly active community. The value of such a system to the people can hardly be overestimated, and the species of confederation that has been worked out, in whatever form it takes, is of public service. There is a great and radical difference between the consolidation of connecting lines and the coalescence of competing lines. In the former case the advantages of united action are gained without damage to the interests of the community. In the latter the public inevitably has the short end of the bargain. Of what real use, for instance, would be a connected interurban system between Boston and New York if it were owned, as is practically the case, by the steam railroads operating between the same points? The whole is invariably less than the sum of the parts when the facilities of competing lines are united by consolidation, which is essentially a vector process! The interurban lines of the Middle West have gone through rapid evolution in the direction of heavy railway service. In roadbed, rolling stock, schedules, methods of operation and useful results they have really approached regular railway practice without forfeiting many of the peculiar advantages which belong to ordinary electric roads.

The effects of enterprise and combined action, whether accompanied by actual consolidation or not, have been very salutary on the roads themselves. The outlook of not a few of these lines was at the beginning rather cheerless and the earnings per mile of track meagre. As time has gone on that condition has improved. With every added link in the network the business as a whole has assumed more generous proportions, and many a line that seemed in a bad way two or three years ago has pulled up into comparative prosperity. It must not be supposed that the relations of these interurban roads have always been those of neighborly love —not a bit of it—but in a large way and with increasing directness of purpose the great Middle West networks have been pulling together in the realization that with united action, formal or informal, would come better business. Nowhere else in the country has the same sort of action been effectively carried out. There have been plenty of opportunities for it, but as a rule the steam roads have effectively prevented any growth that implied active competition. Their official almoners have blocked franchises in the legislatures, or have secured franchises for essential links and checked further action. If franchises have been allowed to slip through, the relations of the railroads to large interests have made it well-nigh impossible to finance the new roads, and in many cases to obtain rights of way. Such influences have worked in the West, as elsewhere, but with less deadly success.

With the larger opportunities of electric traction have come better roadbeds and rolling stock, and much better engineering in every particular. Within the year there has been important work done in reorganizing systems of distribution, replacing small and inefficient power stations, and building large central generating plants in their stead. Most of the last named have been the latest type of steam-turbine stations with superheating, high steam pressure and complete mechanical coal-handling machinery, generating three-phase current at twenty-five cycles per second. Such plants are highly economical and are in a measure independent of the future changes which may come. If alternating-current motors come in due season the present plants are of suitable frequency and voltage. If high-voltage, direct-current practice comes into vogue the change will affect only substation equipment. In point of fact no immediate change is likely to affect the interurban roads now operating, however new enterprises of the larger class may be involved. The road for very high speeds has not yet appeared, and it is no nearer now than a year ago. The trend of running speed is steadily upward, and the big interurban cars roll off miles in sixty seconds or less rather frequently on the longer lines. There are several projects of the 100-mile-per-hour variety, none of which has reached a point demanding consideration here. With generally rising speeds has come, on the whole, greater care and a more scientific system of train dispatching, so that it is pleasant to note this year a better record in the matter of accidents than usual. There have been one or two terrible exceptions like the calamity on the new Atlantic City line. But of the utterly needless collisions, coming from careless dispatching and failure to keep cars under proper control, the list has shortened materially. In connection with the control of cars it is a rather curious fact that regenerative control and electrical braking, both once strongly advocated in this country, have been coming into use abroad though almost unknown here. The bow trolley on the other hand shows some signs of increasing use though not yet to any important extent. Taking it altogether the year past has been unproductive of striking novelties though rich in steadily bettered construction. The apparently successful issue of the New York Central work is great cause for congratulation, and all eyes are now turned toward the neighboring system with its radical innovations. On that field is likely to be soon fought out the issue between alternating-current and direct-current traction for the large purposes of electric railroading.

Development in Electrical Transmission.

By F. A. C. Perrine, D. Sc.

THE industry of the electrical transmission of energy has advanced beyond the stage where, as a child, its progress may be chronicled day by day, month by month, or year by year. It is now full-grown and the very fact that its steps of progress are too many to chronicle and that it has lost its adventurous pioneering character has given men faith in it as never before. Orders do not now accompany the initial undertakings to the effect that all work shall be done on the narrowest possible scale until a "demonstration" has been made; on the contrary the work now done is with the distinct view that power transmission undertakings, where established, are to be considered as essential elements of the local conditions and that a power once developed will thereafter be one of the permanent public institutions, and, in consequence, the execution of the work must be of the best and most permanent character.

Again it is becoming daily more and more apparent that the coal mines and railroads can not so readily supply a permanent and continuous generation of power as the rivers. The past winter has brought this home to all classes and sections of the country till we are now appealing to our highest courts and legislative bodies to relieve us from the perils of a fuel famine which is but a natural outgrowth of a national improvidence which in the past has consumed our store of domestic fuel for power purposes and has allowed to run to waste the easily available power resources of the water which constantly falls upon the mountains and will fall while the earth is habitable.

Cheapness of power has long ago been demonstrated for the hydro-electric plant and transmission line; reliability is now being proved. The duplicate line has already become an established factor in the system, but we are now turning our attention to the duplicate plant as well, and with the study of the problem of the duplicate plant the advantages of the duplicate source for power has also become apparent.

Duplicate plants upon the same water source may not fail simultaneously from machinery troubles, but they are at the mercy of the same droughts and floods while, since distance is no longer an element in their harmonious operation, the plants which are upon different streams, and particularly upon different watersheds, are reliable above all others.

Incidental to this search for reliability the available power for distribution has been increased and the presence of a multiplicity of competing companies has been eliminated, thus warranting an extension of the distribution lines and enlarging the territory and improving the character of the business supplied, especially in reference to the adaptability of load to power available.

Whether it be called engineering or no, this has been the direction of the most recent improvement in the business of electrical power transmission. The writer calls this an engineering advance. The engineer has made the development possible, the engineer has shown its advantages and the engineer has been alone in showing the manner of avoiding the difficulties, which, without his aid, would overpower all advantages in the operation of so complex a system. To-day we rarely hear of a new hydro-electric transmission system which does not involve these elements, and in spite of the many difficulties which attend all large and complicated installations the improvement in reliability and in the adaptability of load to power available turns into profits the very difficulties themselves.

Not only is the unreliability in the supply of coal aiding to this end but also the price is having great influence. The unreliability in the supply of coal is apparent to all, for every paper is filled with tales of coal famine and power plants closed by reason of the "car famine;" but it may perhaps be a surprise to some to know that bituminous coal at the mine mouth has advanced from eighty cents per ton in 1898 to $1.24 per ton in 1903. An advance without reference to combination or retailers' profits. This enhancement in the price of coal is continuous and will continue to be, so that it has become an axiom that the hydro-electric plant which will begin by paying for itself must necessarily become a source of profit in the near future.

Among the difficulties which the above-described extension of lines and plants has made of the utmost importance is that of the disturbance from lightning. Much work and great ingenuity has been expended upon this problem and it can not yet be said that a complete solution has been reached. Lightning arresters on high-voltage lines have been complicated, costly and only partially reliable. For these reasons the transmission companies have sought short cuts and cheaper means. Within the past year it has come to be recognized that in their efforts to escape the difficulties attendant upon the ordinary methods of protection they have discovered a valuable principle of protection, which is that a different type of protection is needed for the long wave length surges than from those of a short wave length. The long wave length surges will destroy all short-gap arresters if they are allowed to pass over them, while the short-wave surges will not pass over the long-gap arresters. The so-called "horn" arrester is the typical long-gap arrester. This will efficiently take care of the long-wave surges, though its discharge may induce destructive short-wave surges unless the line is also otherwise protected. If the line be protected by both the long-gap and the short-gap arrester it may be possible to dispense with the troublesome and expensive overhead grounded wire, provided that the poles themselves are properly grounded, but there is no question that the terminal arresters will fail to protect all parts of a line where the poles are not grounded.

Certain experiences in Mexico indicate that unless the grounded wire be used it is necessary to shield the insulators as well as to ground the poles.

While there is much yet to be learned before we may say that this problem is completely solved, still it is satisfactor to know that so much has been done toward line protection against lightning and that the warring schools of lightning protection have at last begun to understand each other and to find that no one has the panacea which will solve the whole problem. With this understood we may hope to see the long-gap arrester standardized and the short-gap arrester divested of its complications and expense and the two combined, effecting a proper system of protection.

We are often asked where lies the limit of transmission and at what voltage shall these extensive territory-covering systems be operated.

As a matter of fact the method described above for extending plants to cover a great area does not necessarily lead to increased distance of transmission, but often the very opposite is accomplished, for the plant no longer reaches out to reach a single market but rather to cover a territory. Still we must expect many trunk lines exceeding one hundred or

even one hundred and fifty miles, and for such distances it seems inappropriate to hold ourselves down to 60,000 volts, which now has become such a thoroughly established figure.

The present limit of voltage is the design of insulators. The material has finally become reliable and although the present limit has undoubtedly not been reached at 60,000 volts, still from all we can see the high figures will be about 80,000 volts until some other form of designing and attaching the insulator shall be evolved. Work is being done in this direction and the next year will probably see the completion of designs and experiments which will render the use of voltages of 100,000 or beyond as feasible as we now find 60,000 to be, and when our lines and transformers have been designed to handle such voltages as this the problems of switching and short-wave lightning surges will become much simplified.

The use of iron towers in place of wooden poles has become more and more an established custom. Where the proper conditions prevail the spans are being lengthened even beyond 500 feet, which is at present the common spacing for towers. There seems to be no reason that 1,000-foot spans should not be entirely reliable, provided the country passed over is of such a character as not to require towers of too great height and consequently increased expense. As regards the form of tower the problem is too complicated for any general solution and, as a rule, must be solved for each particular case. This in itself is no burden, for each order for towers is of a sufficient quantity to allow the cheapest possible manufacture of any special design.

The new year does not at present show signs of any startling change of methods, but it promises great development of large systems furnishing amounts of power which few have realized were in existence in the territory, and covering with their lines areas which render them of the utmost service to industry and impregnable against competition.

In the midst of this development there may arise at times some cry against those who are said to destroy scenery for commercial purposes; but such a cry arises only from those who fail to recognize that our water power plants are serving a humanitarian purpose of far greater import than the commercial. They are saving for future generations the coal beds which we may never replace, and they are freeing the workers from a slavish bondage to the steam-engine with its belts and ashes and smoke.

The awakening to all of this has begun and the work has already obtained an impetus which is irresistible.

Hydroelectric Developments during the Year 1906.

By Lamar Lyndon.

THE year just ended has witnessed the coming into commission of numerous hydroelectric developments, and the inception of many others that in due course will be important additions to this continually expanding field.

After many years of effort and trial, and after much experience gained at the cost of watchful observation, and often of failure, there seems to have been evolved a fuller knowledge of all the factors entering into the problem of installation and operation, which has lead to the adoption of certain features that now have become general in practice. At any rate, they indicate the tendencies toward which all the more recent installations incline. In fact, some of the characteristics have become almost standard in their general acceptance, as representing the best practice, and the developments during the year 1906 have, in nearly every instance, been based on designs made with these tendencies in view.

The salient features noticeable in the plants of recent years and particularly of that just ended, are:

(1) The adoption of a few large generating units rather than a larger number of smaller size.

(2) The generators are all of the revolving field form.

(3) The number of phases is invariably three.

(4) The frequency for transmission distances of twenty miles or less is sixty cycles per second. For transmission over greater distances the frequency is twenty-five cycles per second.

(5) The operating switches are placed in fireproof chambers or compartments and controlled from a so-called "dummy" or bench-board at some distance from the operating switches which either electrically or pneumatically actuate the operating switches.

(6) Transmission voltages tend to approach 1,000 volts per mile of transmission distance.

(7) The poles or line supports are made heavier and stronger than formerly.

(8) The length of spans of wire from one insulator to the next succeeding one, has been greatly increased.

(9) The step-up transformers are located in separate fireproof chambers and arranged on trucks or rollers to be easily and expeditiously rolled out on the floor of the power station.

These being the characteristics of the later installations it is here proper to enquire into the causes of the general acceptance and adoption of these features.

(1) The tendency toward the use of a few large generating units rather than a number of smaller ones, results from the obvious facts that (a) the cost per kilovolt-ampere is less, (b) the efficiency is higher, (c) the space required in a station is less, resulting in a lower cost for the power-house, and (d) the massive proportions of the larger machines makes them more reliable and less subject to deterioration or injury.

(2) Revolving field generators are now standard for the reasons that they are (a) cheaper to build, (b) less liable to injury, (c) the armature windings being stationary may be better protected and insulated, (d) the rotating portion carries only low-tension current, and (e) the stationary armature windings may be better wound for any voltage that may be desired, as compared with revolving armature machines. The inductor form of generator possesses nearly all these excellent features, but its excessive shop cost puts it at a marked disadvantage.

(3) Three-phase systems are used (a) because the conductors contain only seventy-five per cent of the copper necessary for transmission of the same amount of energy over two-phase lines, and (b) the number of insulators to install and maintain is correspondingly less, other conditions being equal. Three-wire, two-phase transmission lines can be used, but these have the disadvantage of requiring a slightly greater amount of copper than does a three-phase circuit and the potential between the wires is increased. This system is now practically obsolete because

it is not possible to supply machines having closed circuit armature windings—such as rotary converters—from circuits of this character.

(4) The frequency of sixty cycles per second is desirable always when lighting is to be done, as at lower frequencies the change in current flow is perceptible to the eye and lighting unsatisfactory, and if a periodicity lower than sixty cycles per second be adopted the energy from the lines must go through a transformation of some kind to make it suitable for lighting purposes. The disadvantages that attend the use of so high a frequency are (a) the line drop due to reactance is increased, thereby diminishing the power-factor, and (b) the difficulty of running rotary converters at such frequencies—though this is being successfully and continuously done.

On long lines where the inductive drop is marked and a large part of the energy is absorbed by rotary converters the lower frequency of twenty-five cycles per second is used; to avoid the one and improve the operation of the other.

(5) The main operating switches are, by reason of the high-tension currents they carry, manifestly dangerous and must be controlled at some remote point, and furthermore, they should be placed in fireproof, closed vaults to protect the station attendants and also to prevent the possibility of conflagration in case of long arcs due to any current-conducting portion breaking down.

The "dummy" board, which controls the main switches, comprises a number of low-tension, hand-operated switches which are connected to operate the actuating magnets of the main switches, there being a hand switch corresponding to each main switch. Imitation connectors are made or painted on the dummy board which form a *fac simile* of the main-switch connections and thus enable the operator to trace out the connections actually made by the main switch when the manual switch is closed.

(6) The transmission voltages tend to approximate 1,000 volts per mile in usual installations for the reason that under ordinary circumstances this represents the best compromise between a small outlay for conductor and the troubles that menace high-voltage lines. In extremely long transmission lines, where the distances are seventy-five miles and above, the pressure per mile is less than 1,000 volts per mile, as 60,000 volts effective is considered the upper limit for safety under ordinary circumstances because of the difficulty of preventing insulation breakdowns, and also because of the capacity effects, which become marked at high pressures. In some of the longer lines the voltage is as low as 450 volts per mile, while in shorter lines—from one to three miles in length, the pressure is often 2,000 volts per mile and above.

(7) The poles or line supports are being made stronger, both to give an additional factor of safety and prevent the possibility of the line breaking down, and because of the much longer spans of wire which are now being erected, which, obviously, add to the stresses on the poles, cross-arms, pins and insulators. In many instances it has been considered advisable to use steel towers instead of ordinary wooden poles.

(8) The length of wire spans from one insulator to the next has increased enormously. In some lines the spans are as much as 500 feet, while spans of 300 feet and above are frequent. The smaller number of points of support represents a corresponding diminution in (a) the liability of breakdowns in leakage; (b) in the number of poles and insulators to maintain and (c) in the first cost of the line.

(9) The arrangement of transformers in fireproof vaults shows that experience has taught that they sometimes fail and a conflagration ensues unless some such means of confining the pyrotechnics are adopted. Also they can be repaired more expeditiously and to better advantage in an open space where they are accessible. Hence the arrangement on trucks to facilitate their removal from their individual vaults to the station floor.

The foregoing, while representing the almost universal practice and the main reasons therefor, is not invariable. For instance, the Bishop's Creek (California) plant, though transmitting energy 113 miles, is operated at a frequency of sixty cycles per second and 50,000 volts, making the pressure only 432 volts per mile. Another is the Winnipeg (Manitoba) plant, which operates also at sixty cycles per second, the transmission distance being sixty-five miles. Other examples of exceptions can of course be adduced.

The greater number of long-distance transmission plants which have been recently put into commission are in the South and West, though there have been a number of hydroelectric developments of considerable magnitude in the Eastern states.

The coming year seems to give promise of considerable advance in this field, and it may confidently be predicted that its end will witness even larger units and certainly higher voltages in use than the respective maxima of these at present.

The Year's Progress in Electric Railways.

By Sydney W. Ashe.

MARKED activity has been shown in the electric railway field during the past year. This activity has resulted from two causes—heavy increase in traffic due to extraordinary increase of population, felt particularly in the East, and an effort on the part of many interurban roads in the Middle West to make their roads pay. The result of this condition has led to many interesting developments.

New York city furnishes an extreme example of growth. During the first three months of the year the cash fares in New York city increased 12.4 per cent. The Subway has been in operation barely two years and the traffic conditions are almost as bad as before, regarding congestion.

In order to meet more adequately the traffic conditions, particularly on city streets, two-car trains are being operated. This has led to the adoption of emergency air-brakes and multiple-unit control by several suburban and interurban roads. Trial trains have been equipped in New York, Columbus and Pittsburg with this apparatus, and similar cars are being arranged in Boston and Brooklyn. The use of multiple-unit control offers many advantages in the handling of heavy traffic during rush hours, and in working through districts where an increase in the number of single cars would hardly be feasible. The Westinghouse unit switch control has been adopted by numerous roads during the past year for single car and two-car operation. This is a step forward.

In the Middle West—Ohio, Indiana and Illinois—during the past few years, many suburban roads have been built by promoters, which have been over-capitalized. During the past year a large number of these roads have been combined by interests such as the Everett-Moore Syndicate, and the Widener-Elkins Syndicate. In the effort to obtain traffic from parallel steam roads many experiments have been

tried by these Western roads in the nature of schedules, type of cars, etc. In one case sleeping compartments were installed, although the ride was so short that it was impossible for a passenger to get an opportunity to sleep. It has been found finally that the limited service which accommodates, economically, the greatest number of passengers, calls for cars of large seating capacity, seats being comfortable in design, charging no excess fare, baggage on all limiteds, trains every two hours, speeds as high as safety permits, and stops being made in towns of over 1,500 inhabitants. By mutual understanding of several of the large interurban roads, through service has been established, interchanging baggage as well. A noted instance of this is the famous "Lima Route." The competition between several of the interurbans and steam roads covering the same territory has been very keen in some cases, the steam roads being the chief sufferers.

To offset the possibility of combination on the part of "trolleys" and "interurbans," which destroys local traffic, some of the steam roads, namely the Pennsylvania, the New York Central & Hudson River Railroad and the New York, New Haven & Hartford companies are not only electrifying their lines, but during the past year have bought up a controlling interest in many of these small properties. It is only recently that the New York, New Haven & Hartford company has obtained control of practically all of the electric street railways in Connecticut and Rhode Island. The New Haven road has purchased the Rhode Island Company and the Rhode Island Securities Company and has taken a lease in perpetuity of the properties of the Connecticut Railway and Lighting Company in Connecticut. It has also purchased of the United Gas and Improvement Company a controlling interest in several Connecticut power companies to be turned over to the Consolidated Railway Company. The New Haven company, by its purchases, controls 1,350 miles of single track trolley in Rhode Island and Connecticut, and from which the gross earnings amount to $16,000,000 a year. It also controls all but eight small properties out of forty street railways in Connecticut and Rhode Island and is completely protected against electric competition of through lines between Boston and New York.

The progress during the past year in single-phase railways has been extensive, and great credit is due the Westinghouse Manufacturing Company for being pioneers in this field. Although the single-phase system was established on a commercial basis during the previous year and lines were started at Indianapolis, Ind.; Latrobe, Pa.; Vallejo, Cal.; Atlanta, Ga.; Jamestown, N. Y., and Sea Cliff, L. I., using equipments varying from two fifty-horse-power motors to four 100-horse-power motors, inclusive, some of these lines were not started until the latter half of the year. The experience which has now been gained by the continued operation of these lines throughout a period of from one to two years, has firmly established the commercial feasibility of the high-voltage trolley and the single-phase motor in the minds of even the most conservative engineers.

One notable development of the single-phase system is its application to trunk line service on the New York, New Haven & Hartford Railroad, using gearless motors of 250 horse-power each and a trolley voltage of 11,000. These locomotives are arranged for operation also from a direct-current third rail and thus indicate the great flexibility of single-phase motors. This installation is notable, not only on account of the fact that single-phase current is employed, but also on account of the application of electricity to heavy steam railroad service. Another installation, which is notable, both on account of its technical features and for the same reason that it gives an additional example of electricity applied to steam railroad conditions, is the Sarnia Tunnel, electrification of which is now in progress.

The growing importance of the system is further illustrated by the equipment of the Spokane & Inland Railway, a part of which is already in operation; the Pittsburg & Butler Railway; the Rochester & Mount Morris Division of the Erie Railroad, and the Fort Wayne & Springfield Railway, all of which are nearly completed, together with the Visalia Electric Railway, which has been contracted for.

The equipment of single-phase railways with American apparatus is not confined to this country. During the past year, two single-phase lines, the Roma-Civita-Castellana and the Valle Brembana, have begun operation in Italy; and the Storangen Wik Railway in Sweden has been contracted for, all of which will use Westinghouse apparatus.

There have been few developments with new or radical features in railway apparatus during the past year, except, perhaps, in the case of electric locomotives, which are coming into extensive use. The writer remembers particularly a year ago in preparing a text on electric railways, the scarcity of material on electric locomotives in this country, the New York Central locomotive being the only notable instance of trunk line service. There have been several applications in previous years in a small way, such as the Baltimore tunnel and in mining, but nothing extensive. This year has witnessed several new introductions in this field.

As previously stated, the use of two-car trains on city streets has called for improvements in brake apparatus. Several new features have been brought out by the General Electric Company and the Westinghouse Traction Brake Company in the further development of straight air-brake apparatus for this kind of service. The Westinghouse Air Brake Company, during the past year, has improved its AMT equipment by incorporating in the T triple valve a device by which the ordinary service pressure of fifty pounds maximum can be increased, in the event of emergency application, to approximately sixty-five pounds. It has also improved its AMR equipment by substituting the L triple valve for the R, for high-speed service, so that by raising the brake-pipe pressure to ninety pounds, even better results can be obtained, than with their standard high-speed brake equipments, inasmuch as, in the event of the emergency application, upward of eighty pounds pressure is obtained in the brake cylinder, whereas, for service application this pressure is limited to sixty pounds. A very important development in connection with their apparatus embodying the very latest improvements in electrical traction braking is their new electro-pneumatic system.

The most important development in the nature of controllers has been the development by the General Electric Company of a controller for use on combined alternating and direct-current equipments, termed the Sprague-General Electric multiple-unit control for alternating and direct-current operation.

In summing up it may be stated that the year's progress has shown conservative rather than mushroom growth. The problem has been largely to handle the crowds, improve the properties, effect combinations and economies, increase the revenues and give safer and better transit facilities.

In closing the writer appreciates the assistance of Charles F. Scott, A. H. Armstrong, E. H. Dewson, Mr. Metcalf and J. B. Comstock for data for this article.

Electrochemistry and Electrometallurgy in 1906.

By Charles F. Burgess.

COMMERCIAL exploitation of various new electrochemical and electrometallurgical processes, large scale experimental operation of electric furnace proposals with results which promise future commercial success, material increase in the output of electrolytically refined metals, construction of plant for trebling the output of aluminum, and the construction of the largest carbide plant in the country are some of the features which characterize the progress in applied electrochemistry during the past year. No discoveries of great importance or material additions have been made from the purely scientific or theoretical standpoints, though many valuable contributions have been made to the literature of this branch of engineering. The industrial results already accomplished, the enormous development now under way, and the promising experimental work which has recently been done justify the electrochemist in his optimistic expectation of marvelous development in the future.

The result of the progress in electrochemistry and electrometallurgy is made apparent in various other branches of engineering activity. Metallurgy has advanced through electrolytic refining, and in the use of the electric furnace for metallurgical operations; copper refineries have increased their output, electrolytically refined nickel has become an important commercial product, and the electrolytic refining of lead has been demonstrated to be sufficiently successful to warrant the establishment of a new lead refinery which is in process of construction near Chicago.

A study of the chemical industries shows that electrochemistry has, in a large measure, contributed to the cheapening of production and to the manufacture of various new compounds.

From the standpoint of electrical development some interesting facts are to be noted. During the past twenty years electrolytic refining of copper has made it possible to extract this metal from the ores of the western states; aluminum has become a competitor of copper as a conducting material, and attention has been called during the past year to the fact that metallic sodium can now be used as a material for electrical transmission circuits. Much attention has been given to the electrolytic extraction of this metal; and by two or three newly developed processes, which, however, do not appear to have been commercially developed, we are led to expect that sodium may, in the near future, be produced at a cost of less than ten cents per pound. When it is considered that, weight for weight, sodium possesses a conductivity of over three times that of copper the possibility of its becoming a competitor of copper is promising. Sodium has recently been used for electrical conductors by pouring it, while molten, into iron pipes. The practical use of it will depend upon overcoming the difficulties of constructing, insulating, and preventing the risks attendant upon the use of this metal.

Electrochemistry has stimulated the development of water powers, but electrochemical processes have not as yet been able to furnish a satisfactory means for increasing the load-factor of central stations.

THE ELECTRIC FURNACE.

The recent experimental work in "electrothermistry" has demonstrated more emphatically than ever before the necessity of research work on refractory materials, the determination of melting and vaporizing points, specific heats and heat conductivities, the shrinkage, coefficient of expansion, and heats of reaction at elevated temperatures. Much activity exists in producing data of this sort which at present are sadly deficient, and this investigation work is of the utmost importance to the electric furnace designer.

The exhaustive report of the Canadian Commission, which was published in 1904 and which dealt with the use of the electric furnace in Europe in the metallurgy of iron and steel, stimulated much interest in this country in its industrial use. During the past year the Canadian government has carried on experimental investigation at the "Soo" to determine how far the Heroult furnaces might be adaptable to conditions found in this country. A brief summary of the results reported by Dr. Haanel states that the output was found to be greater than the figure adopted in the previous report of the commission; that the smelting of magnetite and desulphurization of pig can be successfully accomplished; that it is possible to substitute charcoal and peat for the coke now universally used; that the consumption of electrodes is insignificant; and that a nickel pig of fine quality may be obtained from roasted pyrrhotite. It is claimed that the process admits of immediate commercial application, and certain it is that with the advantages which have been demonstrated for the electric furnace, the electrometallurgy of iron and steel is about to become a large factor, if power in large quantities and at low figure can be obtained.

A problem attracting a lively interest is the use of the electric furnace in zinc smelting. The deficiencies of present practice as far as thermal efficiency, zinc recovery, deterioration of retorts, and labor are concerned make the possibility of electric furnace application most promising. The economic questions which must be considered in connection with this problem are discussed in the recently published "Report of the Commission Appointed to Investigate the Zinc Resources of British Columbia," and the discussion is on the whole adverse to the immediate possibility of solving the problem, it being pointed out that sufficiently cheap power is not available, and that the difficulties of properly condensing the zinc, and of effecting continuous operation are serious ones.

Silicon, one of the elements which have recently been commercialized, promises to attain a position of importance. Large furnaces have been put into operation during the past year to produce this material. The details of the most successful furnaces employed have not been published, but it is generally understood that continuous working has been attained and that the metal can be tapped from the furnace without interrupting its operation. This being so, with a plentiful supply of ore the cost of production is largely made up of power, and the magnitude of the industry will depend upon the uses which can be found for this element. It is successfully used in the manufacture of iron, copper, and other alloys. Since its melting point is near 1,500 degrees it has been found possible to cast it into various shapes and among the suggested uses of such castings are as a material for electric heaters and resistances, and for crucibles and evaporating vessels for handling corrosive substances both at ordinary and at higher temperatures.

The manufacture of carborundum and alundum (artificial corundum) has been progressing rapidly. The electric furnaces

used in the manufacture of the former product have been increased to 2,000 horse-power capacity. The production of siloxicon, a product of the electric furnace intended for use principally as a refractory material, does not yet appear to have become an important industry.

The demand for and production of artificial graphite have increased. It has been reported that Mr. Acheson recently added to his large list of useful discoveries a method of making a soft quality of graphite, thus greatly enlarging the range of usefulness of the artificial product and making it a more active competitor of the natural graphite in its various fields of usefulness.

Calcium carbide is a product of increasing importance if judgment can be based upon the fact that a new plant near Duluth has just been completed to use 10,000 horse-power for the manufacture of this material.

While not exclusively an electric furnace product, fused quartz has been a subject of study by the electric furnace worker, and it is of interest to note that this substance can now be obtained in the form of sheets, crucibles, muffles, tubes, and the like at a price little more than one dollar per pound, thus making this useful material available for common laboratory and factory apparatus. This fused quartz, although not transparent, has the same properties as quartz glass as far as stability against chemical corrosion and durability against extreme changes of temperature are concerned.

What appears to be an important new use of the electric furnace is in the hardening and annealing of steel. A bath of barium chloride, either alone or mixed with other fusible chlorides, is maintained in a molten condition in a suitable container by the passage of an alternating current between the carbon electrodes. By dipping the tools made of high speed or other grades of steel into this bath the work can be quickly raised to the exact temperature desired without any danger of injuring the tool, and allowing work to be turned out with great rapidity.

VARIOUS PRODUCTS.

The manufacture of electrolytic chlorates is apparently in a prosperous condition. While it is the general belief that the companies manufacturing alkali and bleach are operating on close margins, the outlook seems to be sufficiently good to warrant the large scale working of new experimental processes.

While the Niagara Falls has been the seat of most of the electrochemical and metallurgical development, there is a tendency for the development here to be restricted in the future on account of the active agitation to restrict the power, by governmental regulation, which can be developed and sold. Other hydraulic power centres are under development which promise much cheaper power than can be obtained at Niagara Falls, though in no place in this country has it been demonstrated possible to produce as cheap power as the Canadian commission claims is possible in Europe.

Electrolytic calcium is attracting attention, as it has been greatly reduced in price. It is not at present an important article of commerce, however, though it promises to become so as new uses are found for it.

An event which has been held as of considerable importance in the electrochemical world during the past year is the expiration of the Hall patents, which have been the basis of a monopoly in the production of aluminum in this country. While this expiration makes the only electrolyte available for the commercial production of this metal public property, the Bradley patents, whose term will not expire until 1909 and which control the method of keeping the electrolyte in a molten condition, continue the monopoly. The demand for this metal has greatly exceeded the supply, and it is reported that the Pittsburgh Reduction Company will produce three times as much aluminum per annum as in the past when enlargements now under way are completed.

Much attention is directed at the present time to the problem of fixing the atmospheric nitrogen. A number of important contributions to the literature of this problem have been made during the past year, from which it appears that there are a number of promising ways in which the atmospheric nitrogen may be made to enter into commercial chemical combination. The process which appears to be most successfully living through the experimental stages seems to be the Birkeland-Eyde process, and the technical press reports a factory under erection at Notodden designed to use 27,000 electrical horse-power. It is estimated that 500 kilogrammes of anhydrous nitric acid can be produced per kilowatt-hour. Various attempts are being made in this country looking to the commercial production of nitrates, but thus far no statements as to results are available.

Much of the progress in applied electrochemistry is not a matter of public record, especially where it deals with the production of organic compounds. There is little doubt, however, that interesting and important developments have been taking place in this field.

ELECTROPLATING.

Electroplating, the oldest electrochemical industry, has shared in the general industrial progress through the increasing demands which have arisen for protective and ornamental coatings. No new processes or solutions of importance have been devised, although improvements in various minor details have been effected. The great opportunity for improvement in electroplating lies in the possibility of reducing the labor involved, and, with this end in view, the rotating baskets of various types are coming into extensive use. Automatic machinery has recently been installed for passing material to, through, and out of the tank, and many thousand feet of iron pipe are galvanized per day in a plant in Pittsburgh utilizing machinery of this sort which avoids any handling of metal from the beginning to the end of the process. Electrolytic methods of cleaning as a means for increasing the effectiveness and for reducing labor seem to be coming into more general use.

Electrogalvanizing, which is the newest division of the plater's art, has been making progress, and much attention is being devoted to working out satisfactory methods of galvanizing wire, sheets, and structural iron material. When certain limitations upon present methods are overcome electrogalvanizing promises to become of great importance. The disadvantages which must be overcome are the slowness of deposition, the variations in constancy of the solution, and the inability of the solutions to cause the zinc to strike into hollows or depressions to any extent comparable with that attained in cyanide solutions.

Dr. Bancroft pointed out the possibility of effecting an improvement in the present practice of nickel plating by the use of a chloride in the bath, which will enable pure nickel anodes to be used, thus improving the quality of the deposit and simplifying the maintenance of the solution by eliminating iron, which is present in a considerable quantity in nickel anode and nickel solutions as used at present.

An interesting and apparently new process which has passed the laboratory stage and is now being tested commercially is the deposition of a black nickel coating. This coating has a beautiful dead black enamel-like appearance for which durability is claimed.

The possibility of obtaining cheap cobalt has drawn attention to the use of this

metal for electroplating purposes, and this metal promises to become a rival of nickel.

BATTERIES.

A bulletin recently issued by the Bureau of the Census (ELECTRICAL REVIEW, Dec. 8, 1906, p. 929) gives figures significant of progress in the manufacture of batteries. It is shown that there was in increase of only 3.4 per cent in the value of annual production of storage batteries in this country from 1900 to 1905. To those who hold that the primary cell is an unimportant electrical apparatus it may be surprising to note that the increase in the annual production of the primary cell in the corresponding period was forty-three per cent, an increase much greater than is shown for dynamos, motors, and various other classes of electrical apparatus.

There is little indeed to record in the way of material improvement in storage battery construction.

The use of primary cells, mostly of the dry type, is rapidly increasing, and both the manufacturers and users are beginning to realize that it is important that the design and construction of the cells shall be made in view of the particular kind of service to which they are to be put.

Progress of Electrical Science During 1906.

By John Trowbridge.

THE history of the progress of Electrical Science during the year 1906 is a record of refinement of method and careful study of known phenomena rather than announcements of new discoveries. The scientific world is still under the thrall of the genius of Maxwell and every physicist endeavors to interpret his investigations in light and electricity in terms of the electromagnetic theory. One sometimes thinks, in remembering the controlling influence of great minds, in the past, that electrical science may need to break away from a predominant point of view, just as the subject of light escaped from the limits of Sir Isaac Newton's corpuscular theory. Perhaps if we simply regarded electrical effects as oscillations and studied these effects from this point of view, without confining ourselves to a rigid mathematical theory, we might be more untrammelled.

This thought, I believe, is now in many minds, and those who entertain it can find no better control to an incipient radicalism than in reading Poincarè's "La Science et l'Hypothèse," which has lately been issued in the Bibliotheque le Philosophie Scientifique (Ernest Flammarion, Editeur, Paris). The author shows that whatever theory of electricity or light we may entertain, the differential equations founded on the laws of energy will always hold.

The electron theory of Lorentz continues to meet with more favor than the theories of Hertz and of Lamor. The theory of Lorentz has proved capable of predicting phenomena, and therefore has earned a distinguished title to preeminence. One notices a strong trend among investigators in spectrum analysis and in the general subject of optics to explain the phenomena observed by the excitation of electrons. The prediction by Lorentz of the Zeeman effect certainly leads one to study Lorentz's theory of electricity with the greatest attention. It seems probable that the line and band spectra excited in fluor spar by ultra violet light, observed by Dr. Morse, of the Jefferson Physical Laboratory, and the remarkable series of lines produced by the magnetic field on the fluorescent spectrum of sodium found by Professor Wood, of Johns Hopkins, will find their explanation in Lorentz's electron theory.

In turning from theory to performance, we note important papers upon wireless telegraphy, especially those of Dr. G. W. Pickard. This investigator has constructed a wave-meter, which is already in much request, and is attracting great attention from the United States government. It will readily measure the waves useful in wireless telegraphy to less than one per cent. Dr. Pickard's papers on wireless telegraphy which have appeared during the year form a most important contribution to this art.

The study of the Hertzian waves instrumental in wireless telegraphy appears to have ceased except in their application to this art. In most cases of reflective refraction one can calculate the resulting effects. This is certainly a great tribute to the electro-magnetic theory of Maxwell. It is, however, in the uncalculable field of the discharges of electricity through rarified gases, that we may expect to increase our knowledge of electricity, uncalculable at present, but possibly to become subject to calculation through the theory of the electron.

Stark has lately published a number of papers upon the so-called canal rays, the rays which, so to speak, are shot backward from the cathode through small openings in a plate terminal. These rays proceeding in a direction opposed to those directed toward the anode, exhibit, according to Stark, the Doppler effect, that is, a change of wave length of light, indicating a rapid approach to the observer of the radiating electron, just as the light of an approaching star shows a shift in its spectral lines.

In studying the manifestations of electricity in rarified gases one constantly marvels at its multiform manifestations at the cathode. At this negative terminal we find the greatest sensitiveness to magnetism and to light, and in turn the cathode radiations produce the most varied stimulation of atoms. This is shown in the work of Dr. Morse, I have before referred to, on the production of line spectra in fluor spar by the cathode light. Mr. Adams, graduate student in the Jefferson Physical Laboratory, has recently discovered that the radiations from the cathode separated by a magnet show different powers of penetration through metallic screens.

Not only is the predominance of radiating effects of the negative terminal exhibited in rarified gases. Even in air at atmospheric pressure, this predominance is shown. For instance, the negative terminal of 20,000 storage cells of the Jefferson Physical Laboratory shows a glow in the dark, even when removed several hundred feet from neighborhood of the positive terminal, while the glow on the positive terminal appears first at a distance of about one foot from the negative terminal. When the air, however, actually breaks down under a powerful spark, the phenomena exhibited by the positive pole are more strongly evident than the characteristics of the negative terminal.

While the study of electrical discharges in air and gases promises to extend our knowledge of electricity and magnetism, and give us data which will enable us to test the truth of the electron theory, it can not fail to yield practical results in regard to insulation problems, problems which can not be solved except through the study of conization. While the investigations in electricity during the past year have not opened new fields they have sobered somewhat the field of speculation and prepared the way by quantitative work for new hypotheses.

The Twin Branch Plant of the St. Joseph & Elkhart Power Company.

THE Twin Branch plant of the St. Joseph & Elkhart Power Company is situated three miles above Mishawaka, Ind., on the St. Joseph river. The plant as it now stands is equipped with four 1,000-kilowatt, three-phase generators, 13,200 volts, and two 135-kilowatt exciters, 125 volts.

The switchboard is of the remote control type and arranged in five galleries, with the operating platform across one end of the generator room.

The exciters are direct-connected to three horizontal turbines, the shaft from which is brought from the wheel-pit into the generator room through a cast-iron bulkhead provided with suitable stuffing boxes to prevent leakage.

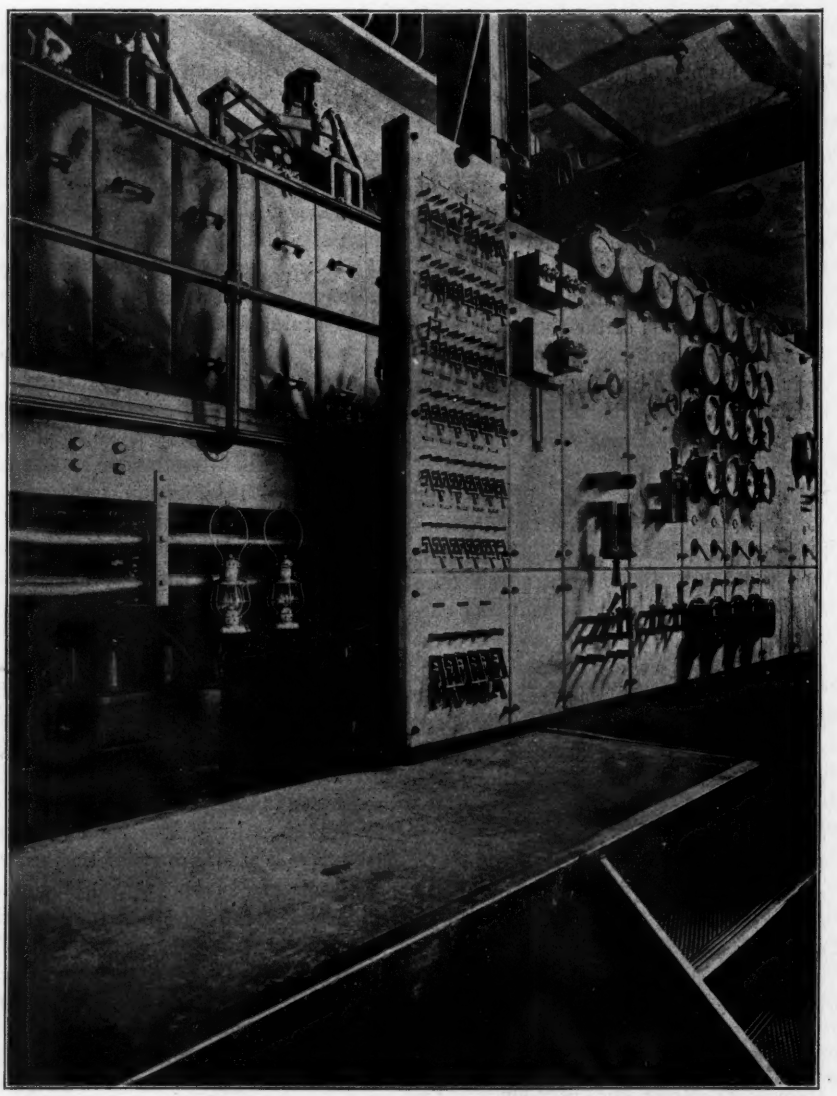
The 1,000-kilowatt, three-phase generators are direct-connected to five horizontal turbines on the same shaft, the shaft being brought through from the wheel-pit into the generator room in the same manner as the exciter shaft. The gate shaft parallels the main shaft and engages the gates of all turbines in the line and is connected by suitable transmission to the governors. The governors are provided with a small motor which controls the ratio of governor speed to generator speed. This motor is controlled by a suitable stopping, starting and reversing switch placed on the generator panel, the governor of which it controls. This motor, in connection with the governor, has such range that the wheels can be stopped and started from the operating platform by use of the aforementioned switch. The transmission between governors and gate shaft is so arranged that in case of trouble with the governor, the gates can be hand-operated without shutting down to disconnect.

Three-conductor cable is used between the generators and switchboard. The current from the 13,200-volt generators after leaving the cables passes through three-pole, oil-insulated, static interrupters located on the first floor, and then to the generator oil switches. The static interrupters consist of a choke coil in series with the generator lead and a condenser connected on the generator side of the choke coil with one set of plates, the opposite set of plates being grounded. The oil switches are of the Westinghouse solenoid-operated type and are on the second floor of the switchboard.

On the third floor are two sets of bus-bars. Between the generator oil switches and the bus-bars are selector switches so arranged that the generator oil switch can be connected to either set of bus-bars or entirely disconnected. The selector switches are provided with an interlocking bar of such design that it is impossible to connect with other than the three bus-bars of one set, and in order to change an oil switch to the second set, it is necessary to disconnect all of the switches from the first set and lock them open before the interlocking bar will release the second set.

On the fourth floor are located the feeder oil switches and bus-junction switch, which are of the same type as the generator oil switches. The feeder switches are, however, provided with an overload release, and are in reality circuit breakers. The feeder switches are arranged to be connected to either set of bus-bars through a set of interlocking selector switches of the same design as those used on the generator oil switches and before described.

On the fifth floor is located a bank of lightning arresters which are of the multiple low-equivalent type and are connected to the feeder circuits through disconnecting switches. All selector and disconnect-



TWIN BRANCH PLANT OF THE ST. JOSEPH & ELKHART POWER COMPANY—FIRST FLOOR OF SWITCHBOARD GALLERIES, SHOWING OPERATING SWITCHBOARD, TRANSFORMERS AND OIL SWITCHES.

ing switches are of the knife-blade type and arranged to be opened and closed with a suitable pole.

The instruments are located on the operating platform. The generator instrument potential transformers are located in individual pockets on the first floor. The generator instrument current transformers are located on the second floor. The secondary current from these transformers is used to operate voltmeters, ammeters, polyphase indicating wattmeters and synchroscope. The bus-bar instrument potential transformers are located on the third floor in individual pockets. The secondary current from these transformers is used to operate voltmeters and synchroscopes. The feeder circuits are provided with two sets of current transformers located on the fourth floor. One set operates the breakers, and the other set, together with the feeder instrument potential transformers located on the fifth floor in individual pockets, operates the feeder power-factor indicator, integrating wattmeters, etc.

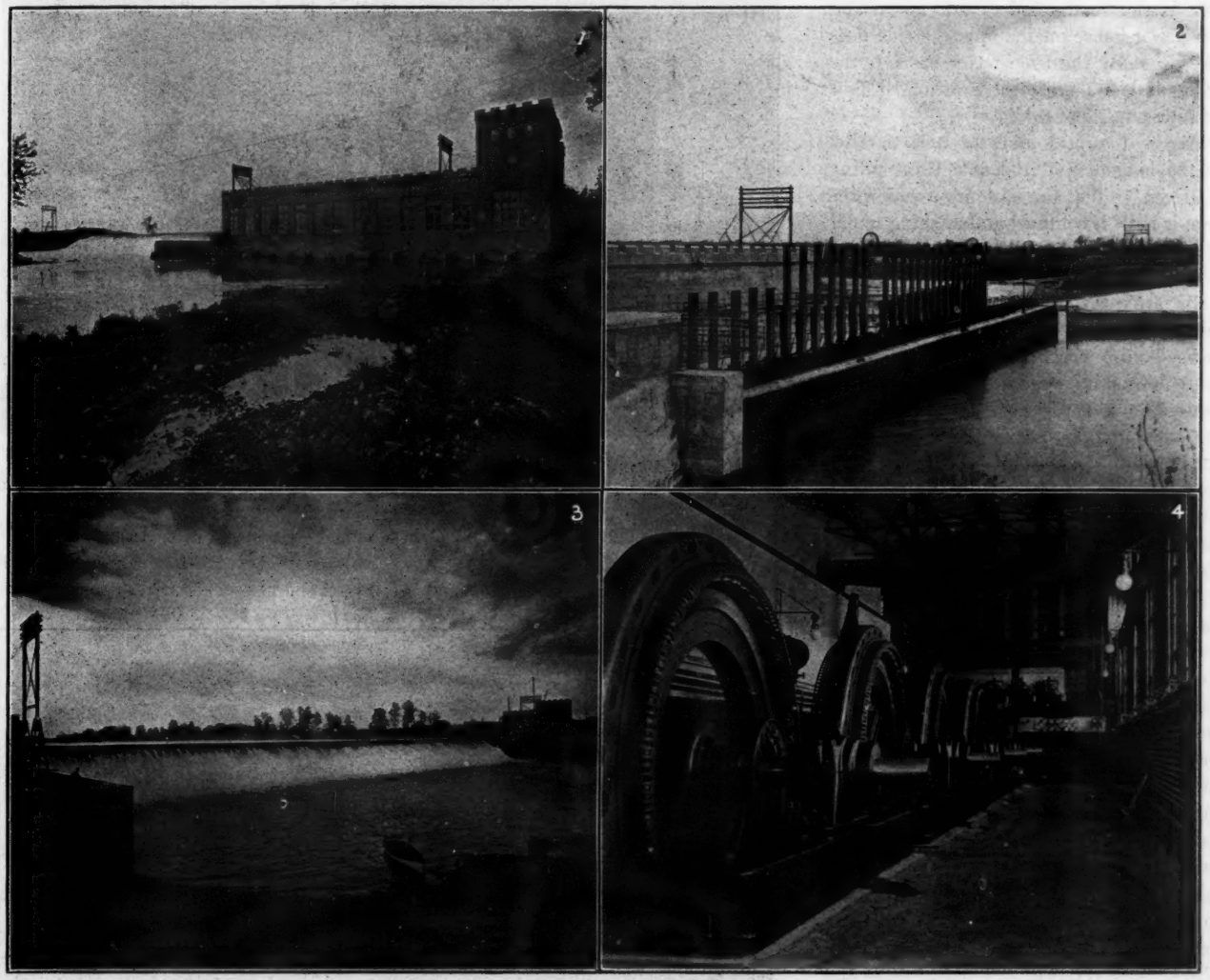
All secondary wires from instrument transformers to instruments are lead-covered and pass through conduits entirely concealed in the masonry as do also the control wires and supervisory wires for the oil switches. There are either concrete or alberene stone barriers between each of the 13,200-volt wires and bus-bars throughout the entire switchboard and where wires are brought through floors they are passed through heavy porcelain floor tubes.

The operating platform equipment is very complete. From it the operator can see at all times the generators and exciters and can stop, start and control the speed of each. All instruments are located on their respective panels together with oil-switch control and supervisory relay showing whether switch is open or closed.

In addition to the supervisory relay the feeder switches have a lamp placed on their panel which lights when they open automatically from an overload or rush of current. The station lighting panel is also placed on operating platform. There is room for the following additional equipment: two 1,000-kilowatt generators with complete switchboard equipment and two additional feeder circuits.

As now standing the works consist of a timber dam 400 feet long, twenty-three feet, measured from surface of apron to the crest of dam, with three feet of flashboards which can be raised when desired. The flashboards are permanently made in to the crest of the dam and are so arranged that they can be dropped in eight-foot sections, one-half being dropped from the abutment on each side. The mechanism is such that the first section is tripped by hand and it in falling trips the second section which in turn trips the third, etc. The entire crest of dam is used as the spillway.

The dam is provided with a fish



TWIN BRANCH PLANT OF THE ST. JOSEPH & ELKHART POWER COMPANY. FIG. 1.—POWER-HOUSE AND DAM. FIG. 2.—FOREBAY, DAM AND HEAD-GATES. FIG. 3.—DAM AND BUTTRESS. FIG. 4.—GENERATOR ROOM AND SWITCHBOARD GALLERIES.

ladder. The dam proper has about a twelve-foot deck and a twelve-foot crest measured parallel to flow of stream in cross section. The apron falls away from the crest on an angle of about thirty-five degrees and makes into a bucket turned on a forty-degree radius, and from where the radius is tangent to a level about three feet below normal tail-water the bucket makes into an apron sixty-three feet in length. The abutments on one side extend to the end of this apron and the power-house on the opposite side does likewise. By the time water has left the apron it has a uniform direction of flow and does not tend to dig.

Across the heel and toe and parallel to the long axis of the dam sheet piling is driven, so that the bottom on which the dam is built is confined and washing under it is prevented.

On each side of the river suitable cut-off walls are provided to prevent washouts around masonry. The foundations of the power-house, wheel-pits, etc., are built on piles driven on approximately three-foot centres to a hard crust which underlies the surrounding land. Concrete, reenforced with steel, is used throughout for foundation work and all side walls are of concrete moulded up in forms in imitation of smooth-faced stone with monolithic cornice work.

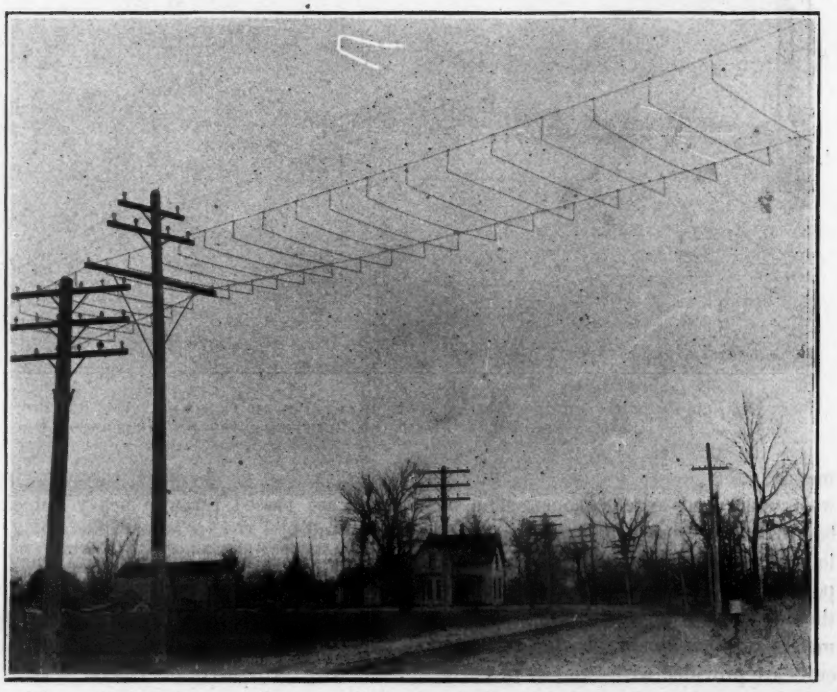
The discharge water from the turbines passes down through draught tubes to tail-water and thence under the generator room. The draught tubes are curved to change the direction of tail-water from vertical to horizontal flow. The sluices into which the draught tubes discharge are carried up-stream above the wheel-pit head racks and are provided with suitable head-gates which when open will by-pass water under the power-house. In this manner the head can be controlled or water pulled below the crest of the dam when repairs are necessary. Logs, grass, leaves, etc., can also be pushed down the front of racks and will be carried under the power-house through these sluices when the control or head-gates are open.

The up-stream edges of the wheel-pit division walls are carried to within about five feet of the head racks and the racks are braced by lateral struts from the vertical up-stream edge of these division walls. This allows the water entering across entire front of racks to flow laterally after passing through the racks to any one wheel-pit, which has been found to be of great advantage during periods of anchor or frazile ice when it is possible to keep certain portions only of the racks clear from ice.

The transmission lines are built on poles of the necessary height to keep a fairly good grade, the shortest poles used being thirty-five feet. The lines are arranged in the form of an equilateral triangle with wires on twenty-four-inch centres and a triangle on each side of the pole. A potential of 13,200 volts is used throughout, no step-up transformers being used in the power-house. At crossings the poles are double-armed and wires guarded with a grounded cradle made up of steel messenger suspension wire from pole to pole at the end of ten-foot cross-arms. Between the messenger wires are swung iron cradle rods, the spacing of which depends upon the distance of cradle above ground.

A private telephone line is built on

TWIN BRANCH PLANT OF THE ST. JOSEPH & ELKHART POWER COMPANY—FIFTH FLOOR OF SWITCHBOARD GALLERIES, SHOWING BANK OF MULTIPLE LOW-EQUIVALENT LIGHTNING ARRESTERS.



TWIN BRANCH PLANT OF THE ST. JOSEPH & ELKHART POWER COMPANY—HIGHWAY CROSSING.

the transmission-line poles and gives good service when conditions are normal and is of considerable value in indicating grounds, etc., on the transmission line.

There are at present three feeders in operation out of this plant. One to Elkhart, Ind.; one to Mishawaka, Ind., and one to South Bend, Ind. At Elkhart the voltage is stepped down from 13,200 volts, three-phase to 2,300 volts, two-phase, and is used for commercial and street lighting and power work throughout the city. At Mishawaka there are two substations. At the Mishawaka city station, the voltage is stepped down from 13,200 volts, three-phase to 2,300 volts, three-phase and used for commercial and street lighting and power, and, at the Mishawaka Woolen Manufacturing Company substation, the voltage is stepped down from 13,200 volts, three-phase to 440 volts, three-phase for motors, and to 110 volts, three-phase, four-wire for lighting. At South Bend the voltage is stepped down from 13,200 volts, three-phase to 2,300 volts, three-phase, and is used for commercial and street lighting and power.

Special attention has been paid to keeping transformers for lighting fairly well loaded and induction motors with their transformers well loaded. Attention paid to these points and the continuous operation of a synchronous motor in South Bend has made it possible to maintain an average power-factor on the plant of between 90 and 95. The large day and night factory load has placed the load-factor of the station at between 60 and 65, load-factor being taken as the ratio of the average to maximum load.

The contracting engineers for this plant were Sanderson & Porter, of New York city, and the electrical equipment throughout was furnished by the Westinghouse Electric and Manufacturing Company and installed under the supervision of one of its engineers. The water wheels were furnished by the Trump Manufacturing Company, of Springfield, Ohio. The governors were furnished by the Sturgess Governor Manufacturing Company, of Watervliet, N. Y. The plant has been in operation since January, 1904, and is one of the properties of the Indiana & Michigan Electric Company, of which F. A. Bryan is general manager.

A Model Electrical Machine Shop Equipment.

By F. M. Felker.

THE new machine shops of the N. P. Pratt Company, of Atlanta, Ga., are an excellent illustration of the adaptation of the electric motor to machine-tool work. Not only are the shops most thoroughly modern in this regard, but they exemplify as well the flexibility of the electric system when adopted in a growing establishment. The change from steam to electric drive has been very complete, yet the motor drives and former belt-driven machines, as well as the new individual motor-driven tools, have been economically combined without consigning the older machines to the scrap heap.

The N. P. Pratt Laboratory is an engineering and contracting company making a specialty of equipment for fertilizer factories, sulphuric acid plants, brick yards, quarries, mines, etc. Historically, the establishment begins with the year 1897, when the Star Foundry and Machine Works were erected in Atlanta, Ga. A year later the name was changed to the "Fulton Foundry and Machine Works," and under that title was purchased by the N. P. Pratt Laboratory in 1904. Until recently this company has operated the factory in Atlanta, but the increasing business prompted the management to erect an entirely new plant at Kirkwood, about four miles from that city, the site chosen being located on the suburban lines of the Georgia Railroad and conveniently reached as well by the city car lines.

In designing the new buildings, George L. Pratt, the engineer of the company, has devoted his personal attention to every detail of the work, visiting the factories of other machine-tool builders and electrical manufacturers in order that the new plant might be a model of its kind. As a result of this enthusiastic study the shops described present many special features of construction and equipment which follow only such a broad enquiry.

A general view of the works (Fig. 1) accompanies this description. The future

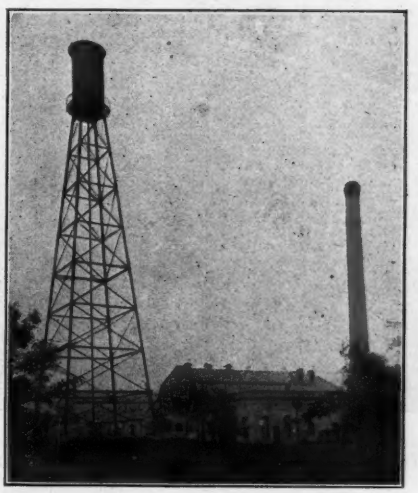


FIG. 1.—EXTERIOR VIEW OF N. P. PRATT LABORATORY MACHINE SHOPS.

growth of the company has been anticipated and provision has been made to extend the buildings to twice their present size. The use of electricity as the motive power, however, will render this easy of accomplishment and additions will not mean overloading line shafts to reach some point from the engine. The buildings are of steel and brick, the construction being thoroughly fireproof. The natural and artificial lighting has received careful study and it will be noted from the illustrations that in addition to the large and numerous windows, special provision is made for overhead lighting. At the point where the main bay drops to the side bay, skylights are provided, set at an angle of about thirty degrees with the wall. Ordinarily, it is customary to place these skylights vertically, but the new method prevents shadows between the main and side bays and tends to give a better diffusion of light. The skylights are arranged in two sections, the upper portion being stationary while the lower part swings from the upper side for ventilating purposes. Ventilators are also placed in the roofs over the main bays. The foundry (Fig. 3) and machine shop are practically duplicates, the only difference being that the foundry is arranged to include a cupola room.

Some idea has already been given of the reasons why the electric drive was adopted in these shops. The ease with which the future growth of the plant could be accommodated has already been mentioned, but there were other considerations quite as strong. The old plant was operated by belt drive and there were a number of old machines which could not well be discarded. With these old machines as one element in the problem was another factor; namely, that machine-tool units be employed in order to cheapen the cost and at the same time accelerate the production of machine parts. The electric drive was the solution of this equation in economics; group belt driving (Fig. 4) for the old machines and motor-

driven units for the individual cost reducers. Added to these specific reasons for installing the electric drive were those inherent qualities of the method—flexibility, operating economy, general efficiency—which make each installation of the electric system an advocate in its own cause.

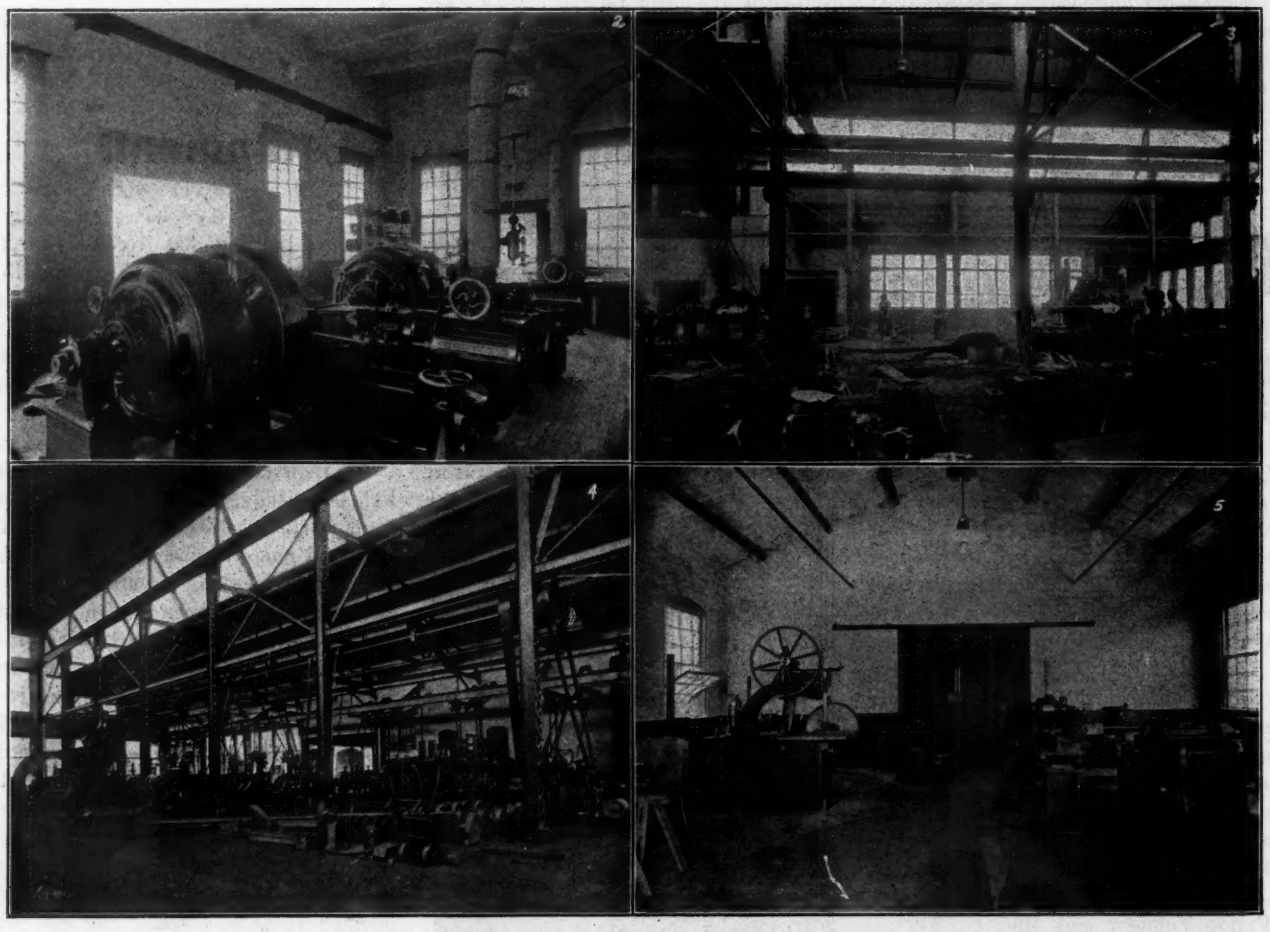
Turning now to the detailed electrical equipment at the shops under consideration, the start is made naturally at the power-house. The generating equipment at the N. P. Pratt Laboratory is located about 100 yards southwest of the foundry

280 revolutions per minute. The generators are direct-connected to Harrisburg side-crank engines. The current is distributed to the factory from a main switchboard built of blue Vermont marble and consisting of two generator panels and two feeder panels. Recording wattmeters are provided to measure the output of the generators. This is one of the niceties of the electrical system, for by this means the exact amount of power used can be told at a glance and the cost accurately calculated.

In the generating room, also, is located

neys which pass up through the front wall of the machine shop, and even on the hottest summer days no trouble has been experienced by overheated air in the conduits.

The main conduits pass under the floor of the machine shop, there dividing into two branches running the length of the building, each of the same cross-sectional dimensions as the parent trunk. Air, steam and electric connections are made from these. The method of wiring the various motors from the ducts is a feature of special interest. The ducts are



THE N. P. PRATT LABORATORY. FIG. 2.—ENGINE AND GENERATOR ROOM. FIG. 3.—FOUNDRY. FIG. 4.—GROUP DRIVE, SHOWING METHODS OF LIGHTING, BOTH NATURAL AND ARTIFICIAL. FIG. 5.—MOTOR-DRIVEN TOOLS IN PATTERN SHOP.

building. In the boiler room two seventy-five-horse-power boilers are installed, set in steel casings. Natural draught is provided by a radial brick chimney 120 feet high with a thirty-six-inch flue. Three steam pumps are installed; one supplies water to the stand-pipe, 130 feet high, and the remaining two are used for feeding the boilers.

In the engine room (Fig. 2) two General Electric direct-current generators are installed, each having a capacity of fifty kilowatts at 250 volts when running at

an air-compressor for operating pneumatic tools throughout the shops as well as for driving an air lift which pumps water from an artesian well. The engine room is served by a small four-ton crane to facilitate repairs.

From the power-house, the power cables are laid in ducts to the main buildings. These ducts are of concrete thirty-six inches wide and forty-two inches high, and carry the steam and air pipes as well as the electric cables. Provision has been made for ventilating the ducts by chim-

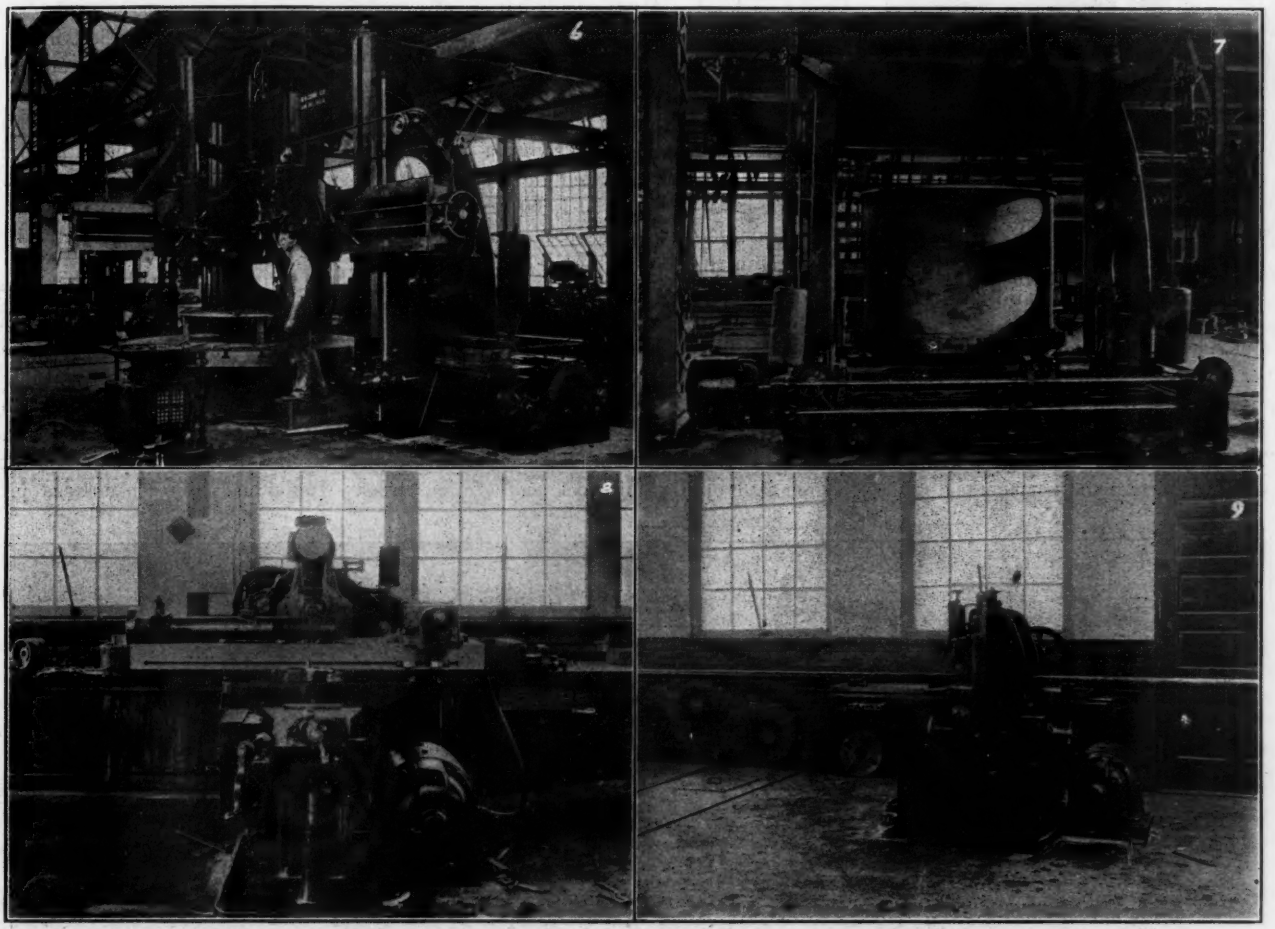
located about the middle of the side bays, as this is the most accessible place from which to wire the motors located in the bays. The floor of the machine shop consists of a four-inch bed of concrete on a solid clay foundation, and above this two-inch by four-inch pine blocks, sawed four inches long, are set on end. The blocks are laid in a coal-tar mixture and the cracks are filled with the same preparation. All of the heavier machines, of course, have their special foundations, but the light machines are placed on the floor and

anchored down by expansion bolts. In order to wire to a motor all that is necessary is to remove a row of the pine blocks leading from the motor to the nearest duct, and drill a hole through the roof of the duct. Conduit is then laid from the opening in the duct to the motor along the trench made by removing the pine blocks. The blocks removed are then deeply grooved by sawing out a V-shaped section and laid over the conduit in their original position. This method has proven very satisfactory, not only making a neat job but enabling the machines to be located conveniently without special attention to the position of the conduits. Cut-ins are located at convenient points about the shops so that portable tools and lights can be quickly connected.

The accompanying illustrations bring out the advantages of the electric drive at the machine tool. The electrical equipment throughout the plant is of the General Electric manufacture. There are installed in the shops twenty-nine stationary motors of both variable and constant speed, aggregating a total of 202¾ horse-power. The constant-speed motors are of the CQ type and the variable-speed motors are of the CR type.

In the pattern shop (Fig. 5) the light open space over the machine obtained by eliminating belts is clearly shown. The single surface planer at the right is driven by a five-horse-power, 1,650-revolutions-per-minute, compound-wound motor. This motor is suspended from timber straps beneath the floor, and at the commutator end the shaft is extended and fitted with an outboard bearing and extra pulley. By this arrangement the motor takes the place of the countershafting, and is belted upward direct to the planer head. The starting rheostat is not visible, but is located to the right of the machine. The thirty-eight-inch band saw is geared to a five-horse-power, 1,650-revolutions-per-minute, compound-wound motor. The starting rheostat, like all the others in the pattern shop, is mounted in a cabinet lined with asbestos and fitted with self-closing doors in order to reduce the fire risk. For a similar reason all the motors are totally enclosed.

Other motor-driven units in the pattern shop comprise a Universal saw bench, driven by a five-horse-power, 1,650-revolutions-per-minute motor; a Universal woodworker, driven by a motor of the same size and speed; and an eighty-eight-inch pattern-maker's lathe, driven by a five-horse-power, 500-1,500-revolutions-per-minute, variable-speed motor governed by a full-reverse type of controller. In the basement below the pattern shop a five-horse-power, 1,650-revolutions-per-minute, constant-speed motor is installed for driving a cut-off saw, band saw and grindstone.

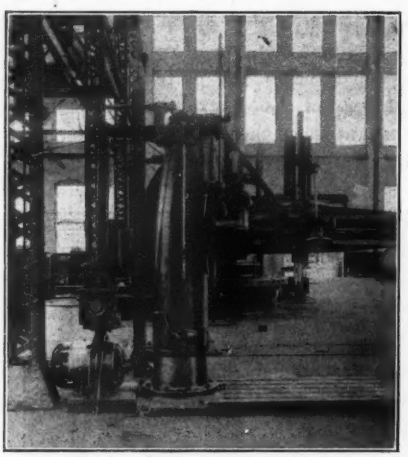


THE N. P. PRATT LABORATORY. FIG. 6.—BORING MILL SHOWING PORTABLE CONTROLLER. FIG. 7.—BORING MILL SHOWING MAIN MOTOR DRIVE, AND SEPARATE MOTOR-DRIVEN RAILS WITH CONTROLLER. FIG. 8.—MOTOR-DRIVEN KEY-SEATING MILLING MACHINE. FIG. 9.—MILLING MACHINE MOTOR-DRIVEN THROUGH CHAIN.

Both the forge shop and cleaning room are electrically operated, a fifteen-horse-power, 1,000-revolutions-per-minute motor being used for a bolt header and two blowers, and a five-horse-power, 1,650-revolutions-per-minute motor installed for the tumblers. There are also two motor-driven emery grinders in the cleaning room. The steam hammer in the forge shop is operated from steam pipes which furnish steam to the heading system and to an engine for the cupola blower.

It is in the machine shop that advan-

tage has been taken of the group method of driving the older belt-driven machines. A portion of such a group drive is shown in Fig. 12, a twenty-horse-power motor running at 925 revolutions per minute being mounted on the wall for this purpose. A similar arrangement on the opposite side of the same bay cares for another group of tools. The tool room is equipped with two motor-driven emery grinders.



THE N. P. PRATT LABORATORY. FIG. 10.—MOTOR-DRIVEN RADIAL DRILL.

The main bay of the machine shop is devoted to erection and portable tool units. The largest machine tool in the plant is a sixteen-foot Betts boring mill, operated by a fifteen-horse-power, 400-1,200 revolutions-per-minute, variable-speed motor, The rails of this machine are driven by a five-horse-power, 1,100-revolutions-per-minute, series-wound motor controlled by a full-reverse type of controller. The fifteen-horse-power driving motor is governed by a similar controller (Fig. 6) mounted on a portable stand so that it can be placed at any convenient point about the boring mill. In Fig. 7 the location of the motors and controller can be seen, the fifteen-horse-power driving motor being at the base of the machine on the left while the rail motor is fixed near the controller on the left side of the boring mill.

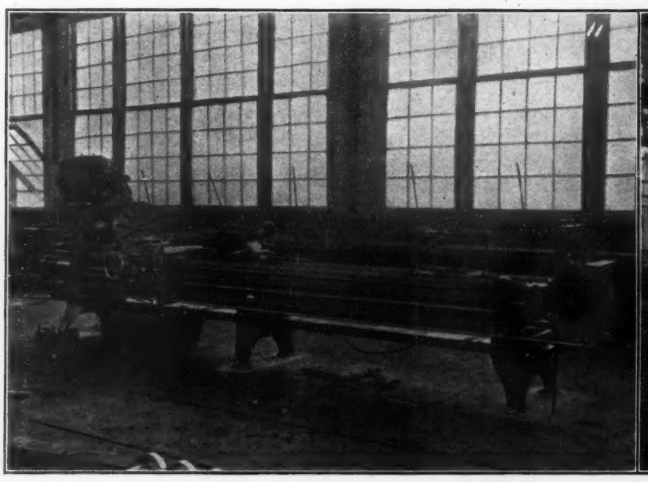
In Figs. 8, 9 and 10 are shown four other representative machine tools. Fig. 8 gives an idea of the motor drive as applied to a key-seating milling machine. The motor, a three-horse-power, 500-1,000-revolutions-per-minute, variable-speed machine, as well as the controller, are both totally enclosed. Another adaptation of the electric drive is shown in Fig. 9. The five-horse-power, 500-1,500-revolutions-per-minute, variable-speed motor is connected to the miller by a chain drive. A neatly arranged method of driving a five-foot radial drill is indicated in Fig. 10. The five-horse-power, 500-1,500 revolutions-per-minute, variable-speed motor is mounted on an extension of the drill-press base, with a non-reversing type of controller mounted above.

The method of adapting the motors to the lathes is shown in Fig. 11. The lathe motors throughout the shop are mounted on the head stock. The illustration shows, also, the method of control. The controller is mounted on the tail-stock end of the lathe and is turned from the apron by a short lever operating through an intermediate rod with sprockets and chain. In some of the lathes the controller is mounted behind the head stock with the controller handle at the lathe apron.

As in all modern shops the transfer of materials at the Pratt Laboratory is accomplished by cranes, hoists and industrial car tracks. The main bays of the machine shop and foundry are served by twenty-ton electric cranes, while the side bays are equipped with four-ton cranes having electric hoists and hand-operated travel. Throughout the plant run industrial car tracks so correlated with the cranes that the transfer of material from freight-car to machine is accomplished with as little handling as possible. A side track of the Georgia Railroad passes through the front of the machine shop and foundry so that loading and unloading can be done with the cranes.

The artificial illumination of the shops is quite in keeping with the natural lighting to which attention has already been called. Eighteen General Electric five-ampere, 110-volt, multiple arc lamps are arranged two in series with inverted concentric diffusers for lighting the machine shop. The foundry is illuminated by fourteen similar lamps and the remaining smaller buildings are lighted in the same way. All the lighting wiring is carried in iron-armored conduits.

In addition to the thoroughly modern electrical and mechanical equipment of the shops, an ample water system is installed for fire protection and sanitary purposes. Attention has been called to the pumping equipment for water supply, a large stand pipe being installed to furnish a constant head. Individual iron lockers are provided for the workmen and hot and cold shower baths are fitted up in the washrooms of the machine shop and foundry.



THE N. P. PRATT LABORATORY. FIG. 11.—MOTOR-DRIVEN LATHE. FIG. 12.—GROUP DRIVE FROM WALL MOTOR.

The Electrical Age.

The capital stock, property and good will of the Electrical Age Company, publisher of the *Electrical Age*, have been purchased by J. H. Smith. The paper will henceforth be issued from 45 East Forty-second street, New York city.

General Tendencies in Central Station Practice.

By Frank Koester.

PRACTICALLY all of the electric current turned on to operate various machinery, be it for railroading, lighting, manufacturing, mining or agriculture, will be produced in a central generating station operated either by water, steam or gas. Great progress has been made in this line of engineering in the last few years and is still going forward at an increasing rate. The employment of powerful water-wheels, superheated steam engines and steam turbines, high-power gas engines and low-pressure steam turbines have been successful, while the development of the gas turbine is being carried forward, although it will probably be some three or four years before it will be manufactured on a commercial basis.

A number of prominent water power plants have been installed of late years in America as well as abroad, the most notable of which are equipped with the Pelton wheel, notable not on account of the size of the plant, but for the very reason that the Pelton wheel was employed. Previous to the practice of transmitting electrical energy at high potential over long distances, the Pelton wheel was very little used, as it requires a high head, usually unobtainable near cities or other centres of distribution. Since the adoption of this method of transmission, however, this type of wheel has become more popular. California and Mexico have been exceptionally progressive in this respect, as might be expected on account of the mountainous character of many of their districts, and their numerous high waterfalls. One of the most prominent of the recent hydroelectric central stations in Europe is that at El Carchado, Spain, for supplying current to the city of Seville. The distance of transmission is some eighty miles and the potential employed is 50,000 volts.

The design and construction of steam power plants has been carried on in America for the last few years with a tendency toward the securing of greater economy in operation. Greater attention is paid to the prime movers in order to secure a lower steam consumption, due to the rivalry between the steam turbine and reciprocating engine, and also the gas engine. The efficiency of the auxiliary machinery is also more carefully considered. The old-time circulating water plunger pump is in many cases being replaced by the centrifugal pumps of greater efficiency, while the open feed-water heater is much favored. The economizer does not seem to be used here as much as in Europe, where it has made rapid strides. Superheated steam is employed in American and English practice up to 150 degrees Fahrenheit, while Continental practice still holds the lead in this respect, employing steam superheated 250 degrees and 350 degrees Fahrenheit. Continental engineers do not limit themselves to standard types of engines, as is the practice in America, and they have therefore been more successful in developing a "superheated steam engine." Also, the Continental steam turbines easily stand a temperature of superheat over 300 degrees Fahrenheit without excessive deterioration and with maximum efficiency. It is the writer's opinion that a properly designed steam turbine should stand a higher superheat than 150 degrees and that such a practice would result in a lower steam consumption, which, in turn, means lower coal consumption.

A well-designed superheated steam turbine or reciprocating engine should produce an indicated horse-power-hour with from nine to ten pounds of steam, provided, of course, that they are working under normal rated load and under normal conditions; that is, with a twenty-seven to twenty-eight-inch vacuum, while the heat units necessary to be utilized from the coal consumed should be between 16,000 and 17,000 British thermal units. These are figures daily obtainable in Continental practice for many years, and in numerous cases even better results have been obtained.

Most of the recently designed steam plants have been equipped with the turbine. Two of the most prominent ones here and abroad, and still under construction, are those of the Potomac Electric Power Company, of Washington, D. C., and the St. Denis plant, in Paris, France. The former when completed will contain three 5,000-kilowatt and two 2,000-kilowatt Curtis turbines and twenty-four Babcock and Wilcox boilers, with three reenforced concrete chimneys. A novel feature of this plant, which has been designed and is being constructed by the J. G. White Company, is that the entire building is made of hollow concrete blocks. Although concrete is much employed in modern power-plant design, this is the first instance that has come to the writer's view where concrete blocks have been employed, and they certainly give a very pleasing appearance to the exterior. The St. Denis plant, which when completed will be the largest in Europe, will contain four 6,000-kilowatt and six 8,000-kilowatt (normal rating) Brown-Boveri-Parsons turbines, while the boiler plant contained in three separate buildings will be equipped with seventy-two marine-type boilers and twelve radial brick chimneys. All auxiliaries in this plant, without a single exception, from that for unloading the coal to that for the removal of ashes, are electrically driven. Mechanical stokers, although usually not much favored on the Continent, have been installed. The floor above the boilers contains the economizers.

As already stated, much more attention is to-day devoted to the operation of the plant, and a number of scientific instruments have been introduced for keeping accurate records of the total coal and water consumption.

The idea of having a low-pressure steam turbine connected in the exhaust of the main prime movers has been materialized. To Professor Rateau the success of this scheme must be attributed. This system, however, is not at present employed in central stations, but is principally in connection with rolling-mill and mining machinery, where the low-pressure turbine is supplied from the exhaust of the main operating engines and used to drive generators supplying current for lights and small motors. As these engines, especially the rolling-mill engines, are operating under great fluctuations of load, the supply is unsteady, and an accumulator with considerable capacity is required between the main engines and the low-pressure turbines. At the other end of the turbine a condenser will be connected. Where a steady flow of exhaust steam is obtainable, such as in central stations, the receiver may be dispensed with. The first plant of the above character was installed in 1904 at the mine Roche-la-Molière and Firminy, in France, where the exhaust from a hoisting machine is utilized. A similar system is in use at the central station of the Steel Company of Scotland. The main exhaust from the rolling-mill engines discharges into a receiver and is fed from here to two Rateau turbines, which supply current for lighting the rolling mill, and also for the necessary small motors. These turbines have a capacity of 500 kilowatts each. After the steam has passed through the

low-pressure turbines it exhausts into one common jet condenser. Provision is made so that high-pressure steam may be drawn directly from the boiler and reduced before entering the turbines, thus enabling them to be operated when the rolling mill is not being worked. These low-pressure steam turbines consume from twenty-five to thirty pounds of steam per horse-power-hour, depending, of course, on the steam pressure at the inlet and upon the vacuum.

A large number of plants have been installed in Europe on the same design, and while it may be stated that these plants are not, strictly speaking, central stations, this type of turbine will undoubtedly sooner or later find its way into the large central stations.

Another type of central station in which steam is generated is where a heating plant is combined with a light and power system. These may be divided into two classes, one in which exhaust steam is used for heating and one in which high-pressure steam is transmitted through a distributing line, the pressure being reduced in the branch mains leading to the various buildings.

In a heating system where the power-house is located at some distance from the extreme end of the main, the practice is to transmit high-pressure steam. A still better result will be obtained by the employment of superheated steam which reduces the size of piping and also reduces the condensation in the mains. As superheated steam in modern power-house design is employed for operating the prime movers, it is natural that it should also be used for distributing.

Prominent central stations have been installed in European cities to supply high-pressure, superheated steam for heating purposes in combination with a generating station to supply current for light and power to the various buildings to be heated; an example of which is that of the city of Dresden and of the University of Darmstadt, Germany.

The gas engine is the most prominent rival of the steam prime mover and has been so developed that for the last couple of years units up to 3,000 to 4,000 kilowatts capacity have been installed. The fact that with the gas engine a kilowatt-hour could be obtained for less than one pound of coal naturally resulted in the quick market which it has received. There is a certain disadvantage in the gas engine, especially in American practice, where it is customary to sell the large prime movers with an overload capacity of fifty per cent, in the fact that the former has an overload capacity of only twenty per cent. It makes it necessary, therefore, to install more units in order to obtain the same ultimate capacity. The gas engine is also comparatively less economical at fractional loads.

In districts where natural gas is obtainable and in rolling-mill and mining districts, where the waste gases of cupola furnaces, etc., may be utilized, of course, the gas engine has undisputed claims, and it will probably not be long before large gas-engine central stations will be installed in mining or rolling-mill sections, and by means of high-tension current, power distributed over wide areas. These stations may at the same time be in connection with a steam-driven plant. A scheme similar to this has been under consideration in Germany for a number of years and is now being rapidly pushed toward completion. The most important industrial district of Germany, that of Reneland, Westphalia, will have in the near future a system of central stations to supply the great number of manufactories and towns both for municipal and private purposes, with light and power. Provisions are at present made for two central stations located directly at the mines, and steam-driven, while a third location will be to the south of this district. The company controlling the system was formed with a capitalization of 60,000,000 marks and made contracts with the mine and iron-mill owners to buy their surplus current which they produce from waste gases, etc., for three pfennigs per kilowatt-hour, and at the same time made contracts to sell power to the consumers at six pfennigs. These figures are based on large consumption, while small consumers are charged from fifteen to thirty-two pfennigs per kilowatt-hour for light, and from six to fifteen pfennigs per kilowatt-hour for power. (Four pfennigs = one cent.) The three central stations will, of course, run under partial load day and night and will supply the requisite power not obtainable from the mines, etc. The most prominent station, located near Essen, contains two Brown-Boveri-Parsons turbines, each direct-connected to a 5,000-kilowatt alternator and a 1,500-kilowatt direct-current generator, besides which there are several reciprocating engine units and two 5,000-kilowatt turbines of the same make. Still larger units than the above-mentioned (7,500 kilowatts) are at present under construction. It will be noticed that by careful study of such conditions and the installation of proper systems, combining steam and gas-power plants, very gratifying results may be easily obtained.

Illuminating Engineering.

By L. B. Marks.

BROADLY speaking, illuminating engineering covers that branch of engineering which concerns itself with the production and utilization of light. It is in the narrow sense of the term, or that phase of the science which deals with the utilization of light, that illuminating engineering has during the past year received notable attention. In fact, so far as the scientific study of the underlying principles governing the distribution of illumination from light sources in concerned, illuminating engineering, as applied to the problems of every-day illumination, may be said to have during the year achieved the status of a definite and distinct branch of engineering.

That this branch should have been so long neglected is indeed surprising, but the fact may be accounted for in a measure by the pressing need for solution of the multitude of engineering questions relating to the production and distribution of the power from which the light is produced. Now that electricity and gas can be produced and transmitted with comparative economy, the engineer naturally directs his attention to the problem of obtaining the best illuminating result from a given expenditure of either the one medium or the other. In the field of gas, the scope of his engineering is perhaps to some extent circumscribed, but in the field of electricity he has a wide berth. The remodeling of wasteful installations is in itself a huge task to be accomplished; but the application of scientific principles to the design of new lighting layouts, opens up a still broader and more important avenue.

In the engineering of electric illumination these considerations apply at the present moment with perhaps more force than ever before, for at no time in the his-

tory of electric lighting have we been brought face to face with more vital problems in illuminating engineering than confront us to-day. The development of the mercury arc, of the flaming carbon arc, of the magnetite arc, of "tube" lamps and of metallic filament incandescent lamps has, at a jump, as it were, given birth to a new art.

With these lamps and others now on the market or near the commercial stage, good illuminating engineering means not only the solution of the problems of the day but wise provision for the substitution of improved light sources in the near future.

Unlike some of the exact sciences, illuminating engineering has a marked limitation in that it deals necessarily with physiological effects for which we have no adequate physical measures. We may measure the candle-power of a light or the foot-candles of illumination produced by the light, but this does not tell us exactly to what extent the light enables us to see.

We can, however, go a great ways toward producing the best results if special consideration be given to the type, size and number of the light-units used, their location, and the character of globes, shades and reflectors employed.

In determining on these various points, we must consider whether the desired results can be best obtained by the use of general or of localized illumination, or both. In some cases, either the one method or the other taken alone would result in failure. In others the combination of the two might be disastrous. Much will depend also upon whether the lighting is direct or indirect, that is to say, whether the rays pass directly from the light sources to the object to be illuminated or whether they reach the object only after reflection from the walls or ceiling.

In considering the type of illuminant best adapted for a given condition, the color of the light is an important factor. Although two lights may have precisely the same candle-power, according to the photometer, we may in some instances be able to see much better by one of these lights than by the other because of the color differences in the lights.

In some cases a large unit will give a better illuminating result than a number of small units the sum of whose light-radiating powers is equal to that of the large one, and *vice versa*.

The location of the light sources with reference to the walls or ceiling may make a tremendous difference in the resultant illumination, even though the outlets be uniformly distributed throughout the enclosure.

Another important consideration is the proper use of globes, shades and reflectors. By the aid of these we can greatly modify the natural distribution of illumination from light sources, direct the path of the issuing rays almost at will, and soften the light to the extent required.

The softening of the light, or reduction of its intrinsic brilliancy, is one of the most important factors to be taken into consideration, particularly if the light sources are within the ordinary field of vision, as they often must be.

I have indicated above, some of the fundamental questions which come up in illuminating engineering. Concerted effort is now being made to carefully study these questions and formulate, as far as possible, laws for the practice of the science. Much has already been accomplished in this direction, as evidenced by articles which have recently appeared in the technical press and particularly by the valuable papers and discussions in the transactions of the Illuminating Engineering Society, which was organized just a year ago for the purpose of studying these very matters.

It is a significant fact that within the past year we have come more and more to measuring illumination rather than candle-power. In designing illuminating layouts we are now calculating in advance and specifying the amount of light in foot-candles to be delivered on the surface to be illuminated, instead of as in the past considering only the watts per square foot or candle-power per square foot of surface area, or per cubic foot of contents of a room.

It is also significant that we have realized more fully the importance of the physiological side of the question in studying the problems of illuminating engineering. We know that the eye automatically protects itself within certain limits against bright lights within the field of view. In the past we have transgressed these limits, but now we are beginning to rectify our errors and avoid their repetition. In this connection I may state that in the design of the lighting layout for the new office and exhibition building of the Edison Electric Illuminating Company, of Boston, nearing completion, not a single unscreened illuminant is used throughout.

The adoption of definite nomenclature and standards would assist in systematizing the practice of illuminating engineering. Some progress has been made during the past year in bringing about such standardization, and it is hoped that national or international action in the matter will soon be taken.

Though a vast amount of good work in illuminating engineering has been accomplished, we have only just "scraped the surface." We still find at every hand flagrant violations of the elementary principles of good illuminating engineering. There is much room for improvement in the illumination of the home, the office, the store, the street. We still continue to face the glare of bare lamps in our trolley cars, and to submit to the bright exposed lights in our places of amusement. Sometimes we even buy our lighting fixtures by the pound regardless of their illuminating value!

But all this is changing, slowly but surely. The quicker we can spread the principles of good illuminating engineering broadcast, the better for the visual comfort of us all.

Review of Telephony for 1906.

By Edward E. Clement.

THE telephone business in the United States during the past year has kept full pace with the most active of our other industries. Reflection will show this is a pregnant statement, for it has been the biggest year in the history of our country in every way. Prosperity has smiled on every effort, and success attended us in spite of the financial drawbacks we have had to contend with.

It is conservatively estimated that during the past eight years more than 7,500 new companies have been started in business and there are now somewhere near 7,000,000 subscribers' telephones in daily operation. A considerable part of this development has been achieved in the last part of the period named, and much of it in 1906, under most adverse financial conditions. The present rate of extension of investment is estimated at from $150,000 to $170,000 per day aggregate. The total rate of physical extension is about 50,000 telephones per month, or the equivalent of

an exchange of 1,700 subscribers installed complete every working day in the year. The independent organizations alone have 7,400 companies operating in 12,000 cities and towns, with over 3,500,000 telephones.

The most significant feature of the situation at present is this: The telephone as a public utility is an established fact in the public mind, and days of missionary work to this end have now come to fruition. The question of whether or not a telephone with exchange service would be useful no longer occurs to most prospective subscribers, but only the familiar question of whether it can be afforded or not. It is true that in many cases competing companies operating in the same territory have cut rates, and in many cases rates have been lowered in anticipation of competition, but wherever this has been indulged in to any substantial extent the margin line between profit and loss has been approached, and in some cases passed.

The problem which confronts every telephone man in this country at the present moment is how to obtain permanent financial relief, and how to better the market for legitimate securities. Accusations are made both by Bell and independent officials of over-capitalization, and I do not doubt there is truth in some of them, but apart from this, and assuming that the character of the securities offered can be raised in every case to where it should be, the fact still remains that this industry, in common with all the others, is suffering from the effects of our present financial system. As a deduction from the lessons of 1906, there need be no hesitation in assuming that the coming year will witness further expansion of marvelous character, limited only by financial conditions.

A second problem confronts every manager and board of directors, *i. e.*, how to increase earnings or reduce expenses of operation and maintenance, or both. Where rates were originally fixed too low, and where the growth of the exchange has been beyond anticipation, this problem is more serious than it ever has been. I may add that this is the rule and not the exception. It will undoubtedly be found in the very near future that measured service will be forced in the majority of instances.

Regarding the progress of invention, the year has been most interesting. There have been issued about 365 patents, or an average of one per day. Of these, sixty-nine relate to manual systems, that is to say, circuits and apparatus for exchange service; sixty relate to miscellaneous features and attachments of and for subscribers' instruments; forty-two relate to party lines, with selective signaling; thirty-two cover automatic or semi-automatic systems and apparatus; thirty-one are for transmitters and receivers; twenty are for switchboard annunciators and relays; nineteen are for switchboards, and details of construction thereof; seventeen are for composite systems wherein telephone wires serve concurrently for other purposes; nine cover service meters; nine relate to ringers; eight are for intercommunicating systems; eight are for subsidiary devices, including protectors; four are for toll apparatus; three are for distributing boards; eight are for operators' keys; and seven are for telephonic relays or repeaters.

Space will not permit more than the briefest reference to the most important of these patents, although almost all of them well repay reading, there being very few productions of cranks in the lot.

The Shreeve patents, assigned to the American Telephone & Telegraph Company, are of interest and importance, both because they relate to the rather sensational idea of relaying voice currents through two-way repeaters, and because they are stated to cover the commercial apparatus now being used by the Bell company. The basic feature of the apparatus is the employment of a transmitter of the White solid back type, with a small iron projection on the diaphragm which extends into the actuating coil. Other features are the winding of the repeating coils as a unit, so that the single repeater is bridged across the circuit to act as a booster; also the balancing of the circuits, etc.

Another interesting repeater is issued to Professor Trowbridge, of Cambridge. His scheme is to relieve the receiver diaphragm of its central load by providing a separate vibrator closely coupled to it and connected to the transmitter element.

Perhaps the most sensational aspect of our telephonic development is to be found in the automatic side of the business. It seems almost incredible that this Ishmael of the tribe, with every manual engineer's hand against it, should have succeeded, with admittedly defective apparatus and circuits, in attaining to the prominence which the last year has seen conferred upon it; for it may truthfully be said that automatic development in every phase, commercial, manufacturing, inventing, and operating, is miles in advance of everything else. Cold-blooded directors and managers, of course, look only to the question of reduced costs, which in many cases are made good by automatic, but this does not account for the attitude of the public, nor for the attitude of the operating engineers, who are rapidly losing their hostility and becoming friendly.

One new manufacturing company has got under way during the year, whose efforts are directed exclusively to supplying automatic central office apparatus, and the patents indicate a settled determination to provide non-infringing devices as substitutes for those of the Automatic Electric Company, which with the Strowger apparatus, has heretofore practically monopolized the field. This company, however, is apparently waking up, and realizing that the original Strowger switch patent is about to expire, is now doing what it should have done long ago for its own protection, *viz.*, filing a large number of applications covering the many details of its peculiar apparatus and circuit. Eight of the automatic patents issued during the year are assigned to the Automatic Electric Company, all important, the most important pair, however, covering in many claims the construction of the selector and the connector switches employed in its exchanges. Others among these patents cover pilot lamp connections, means for charging storage batteries, the feature of a selector switch making and breaking its own circuit, the grouping of the selectors and their cable connection on the frames, etc.

The Clark Automatic people get three patents, all in the name of Anthony Van Wagenen, covering various means of using a bridged common battery and metallic circuit, which the Strowger people have never been able to do.

Patents of individual interest are the following: Two to Lundquist, and one to Merryman & Allen, for impulse transmitters or subscriber's "dials" which look like the Strowger but do not infringe, in intent at least; one to Faller for his cumbersome system of cross-connected lamp signals in his semi-automatic system; one to Land, of Grand Rapids, for a semi-automatic circuit employing Strowger switches and ordinary subscriber's common battery instruments, and finally, most interesting of all, six to the Western Electric Company for switches and circuits for their common battery automatic system. It is known commonly, that the Bell and Western Electric are using automatic systems for small exchanges; and it is now getting to be common gossip that they are well converted, with a thorough change of heart, in regard to the equipment of large exchanges, pre-

ferring semi-automatic equipments, however, in which the switching is performed by operators.

A rather interesting patent in this class is that to Stevens, for an impulse transmitter having a keyboard like a typewriter.

Most of the party line systems are of little importance, being of the hackneyed varieties, using step-by-step or other well-known expedients. One, however, deserves mention, since it presents one of those beautiful conceptions which, though only improvements on existing methods, have firmly established the high reputation of William W. Dean. Mr. Dean, of course, is the direct progenitor of all the present harmonic signaling systems, having deservedly taken this honor away from the earlier designers like Lighthipe and Currier, who failed utterly to put their ideas in practical form. It has been found by Mr. Dean that while there is practically no tendency for high-frequency currents to affect low-frequency bells, the reverse is not true, since currents of low frequency have a strong tendency to affect the high bells. This was considered insuperable until Mr. Dean conceived the idea of adjusting his voltages and his capacities so that the potential would vary directly as the frequency, and the capacity in any particular bridge would be inversely as the current frequency intended for that bridge. With this arrangement there is no tendency to interference. The voltages adopted are from fifty to two hundred, with frequencies ranging from 16.6 cycles to 66.6 cycles, the capacities being from one-quarter microfarad to two microfarads.

In the system class is another beautiful idea of Mr. Dean's which deserves notice: This relates to automatic ringing of a called subscriber's bell, controlled by the called subscriber himself. This has heretofore been done only by the Bell people, the control being through the medium of electro-magnets, in some cases interposed directly in the talking circuit. The method thus adopted by the Bell company, and covered by their patents, is to have the controlling electro-magnet or relay so connected that the ringing current will pass through its windings, without effectively energizing the same until the subscriber answers, when the rush of current due to his placing his low resistance talking set across the line will act to cut off the ringing generator. Obviously either of these methods is inefficient and objectionable. Mr. Dean employs a thermic relay, comprising a pair of wires under spring tension and extending to points on a pivoted lever so as to hold the same balanced on its pivot. The generator circuit is connected through one of these wires only, which offers very little ohmic resistance, and absolutely no inductive resistance. The operation is similar to that of the older schemes, but for obvious reasons constitutes a substantial improvement thereover. For changes in external temperature, this instrument is irresponsive, since both wires expand and contract equally, thus remaining balanced, but when the subscriber answers the consequent rush of current through the one wire heats the same and destroys the balance. It is a curious fact that the original patents on automatic ringing, containing the basic claims, were also Mr. Dean's.

The switchboard patents for the year are unimportant, relating only to mechanical details. The majority of the protective patents have issued to Frank Cook, who is very active in this line, and the general system patents are pretty well divided up, the most important going to the Western Electric, Stromberg-Carlson, and the Kellogg companies. None of them have any startling features.

Among the ringers there is one patent of importance, No. 809,060, to E. R. Hobbs, which is assigned to the Dean Electric Company. It covers a central spring armature suspension which is important in the practice of harmonic signaling.

This concludes the review of patents, but it should be borne in mind that much inventive work has been done during the past year which does not appear in these patents and which may not so appear for some time, because applications which are filed in the Patent Office do not always ripen into patents at once. It is known that several of the large interests, and I may add probably many individuals, have been conducting interesting experiments looking to improvements in our present methods of operating. It is realized that the manual switchboard and methods of operation have reached a finality, no fundamental changes having been made therein for at least ten years. During those ten years automatic apparatus and systems of operation have been developed and brought into commercial use on a considerable scale, and although the automatic apparatus thus made available has been admittedly crude from a mechanical standpoint, and has been unable to furnish certain kinds of service such as four-party selective, pay stations, etc., nevertheless it has shown its capability for competing with manual apparatus, and is claimed in many cases to produce good results in the way of economy of operation and maintenance. The change from standard manual equipment to the present type of automatic equipment is too radical to be generally possible. Moreover, if there is any advantage beyond the amusement of some subscribers in having the subscribers do the work of connection, it is not sufficient in the great majority of cases to justify the sacrifice of good manual equipment. From the standpoint of the engineer and the manufacturer, it appears also an unpardonable error to even think of throwing aside all of the standard practice most painfully evolved through thirty years of hard work by some of the most capable men this country has ever seen. This is not sentiment but hard common sense, and it is an absolute fact that until quite recently the automatic people as a class have chosen to completely disregard manual practice, creating laws unto themselves; while the manual engineers have quite as completely ignored what courtesy may denominate "automatic practice."

To the unprejudiced mind, it appears that there is much merit in the automatic apparatus and systems thus far developed, but not as much as their blind advocates would assert. The problem of to-day, therefore, is how to utilize the meritorious features of automatic without sacrificing the good points of manual practice, and without producing such complete changes as to cause losses out of proportion to the benefits conferred. There is no question that in this age of high-speed elevators, rapid transit, and fast express trains, the public has a right to demand rapid telephone service, which is a more important means of communication than any of the others. Nevertheless, the natural restraints due to safe-guarding heavy investments, and the fortunate inertia of the human mind, should and will undoubtedly bring about much needed improvements on conservative lines.

The conclusion seems inevitable that the system of the future, even of the immediate future, will involve a combination of manual and automatic methods, affording a maximum of simplicity and therefore economy in the subscriber's apparatus, and a maximum of efficiency with economy at the central station.

Take it all in all, all the prospects are very bright for the coming year, and for everyone engaged in this industry.

A Review of Telegraphy.

By William Maver, Jr.

SO FAR as the technical side of wire telegraphy is concerned there is little to be said that is strictly new. The telegraph industry has pursued the even tenor of its way during the year just closed, as it has done for the past twenty-five or thirty years, with little or no variation in the methods of operation, unless we except the use of the manually operated keyboard transmitter, and the employment of the ordinary typewriter by the operators as a means of transcribing telegrams. In this country the duplex and quadruplex systems, operated on the manual Morse or the Wheatstone automatic principles, are still, with the single-wire Morse, the only systems in extensive use. The attempts to introduce long distance printing telegraph systems here have not hitherto met with much favor. The Barclay modification of the Buckingham printer is in successful operation on several circuits of the Western Union Telegraph Company. In Europe the Murray printer appears to be making some headway against, or in conjunction with, the Hughes and the Baudot printers. The Delany multiplex system, which was in operation for many years in the British post-office telegraphs, has been set aside and is no longer employed in that service.

In this country telegraph engineers are, in many places, encountering serious difficulties in the operation of their circuits by the encroachments of electric traction systems. As the employment of high-potential alternating current for electric traction purposes expands, as it is doing very rapidly throughout all parts of the United States, it is obvious that telegraph engineers will have to face numerous problems from harmful induction and conduction effects from this cause. It is, in fact, not easy to foretell what the ultimate effect of these high-potential alternating-current circuits upon the telegraph service will be. In the event of the general electrification of steam railways it is probable that it will, in many cases, become necessary to remove the telegraph lines from the vicinity of the railway tracks and seek rights of way removed to a safe distance therefrom. Indeed, this action has already been taken by one of the telegraph companies between New York and New Haven in anticipation of the electrification of the New York, New Haven and Hartford Railway. Possibly, however, as has more than once happened in the past in electrical matters, means may be devised whereby by mutual concessions and by cooperation it may become possible for these various interests to "live and let live," without undue hardship on either side.

The competition of the telephone companies with the telegraph is growing more pronounced yearly, not so much in diminished receipts of the telegraph companies, since there is no decrease, but a gain in these receipts, but rather in the great increase in the toll business and in the increase of wire mileage of the long-distance telephone companies. However, it is a well-known fact that the telegraph interests, in common with all other lines of industrial business, are at present enjoying an era of great prosperity; the managers of these companies being put to it to find wire facilities to handle the business offered to them. This statement is attested by the fact that the last annual report of the Western Union Telegraph Company showed a gain of 4,000,000 messages over the previous year. Furthermore, the actual growth of the telegraph business in this country is no doubt greater than appears on the surface, inasmuch as the statistics of one of the large telegraph companies are not available for comparison.

It is, perhaps, fitting in a review of telegraphy to refer to the great work rendered by the telegraph companies to the public at the time of the calamity that befell the city of San Francisco last April. The earthquake destroyed the buildings and the poles and wires of the telegraph and telephone companies, and for hours the rest of the world was without knowledge of the extent of the catastrophe. By dint of arduous and unremitting labor and at great personal risk, the operators of the telegraph companies sought out the cable terminals of the circuits and succeeded in opening up communication with the outside world, thereby at once lessening the anxiety that was increasing with every moment of silence as to the fate of the city, rumors having been rife that the ill-fated town was razed to the ground and that the loss of life was appalling. Temporary headquarters were erected and the operators worked night and day, until many of them collapsed, in the attempt to cope with the deluge of telegrams to and from the distracted relatives of the sufferers in other parts of the country. Besides the telegraph there was no other source of information concerning conditions in the city for several days after the calamity. The telegraph companies, although amongst the heaviest losers by the calamity, issued free bulletins relating to these conditions to over 23,000 points in various parts of the United States, and all messages dealing with the relief of victims of the disaster were also transmitted without charge. Of course, all messages to and from San Francisco were accepted subject to delays, and in the chaotic condition of affairs then existing the prompt transmission and delivery of messages was impossible. The difficulty of finding people at that time is well illustrated in the fact that one of the best-known residents of the city, the manager of one of the largest hotels there, could not be located until twelve days after the earthquake, although every effort was made to that end.

Finding it impossible with the limited wire facilities at their disposal to handle the immense volume of business forced upon them, but which as common carriers they could not refuse to accept, the telegraph companies despatched special messengers to points beyond the affected district, from which points the messages were telegraphed to their destination. This action is obviously the best, and in fact, it is the customary method followed in all serious cases of obstruction to traffic, to facilitate and hasten the delivery of telegrams. Unfortunately, this unavoidable and highly necessary action was misunderstood and misconstrued by many people of the ill-fated city, and in consequence severe animadversions, which, in view of all the facts, were as ungracious as they were undeserved, were passed upon the companies several months after the disaster.

RADIO TELEGRAPHY.

With reference to wireless telegraphy also, it can not be said that there has been any very marked progress in the technical development of that art during the past year. Several interesting and novel detectors have been recently brought out, however, namely, the carborundum detector, due to Gen. Dunwoody, the De Forest audion, and the Pickard silicon detector.

The carborundum detector has been quite extensively employed in practice by the De Forest company and has proved to be commercially serviceable.

It is said to lack constancy of operation

unless proper care is exercised in the selection of the crystals. In practice, a piece of carborundum about one cubic centimetre in size is clamped between two brass terminals or electrodes. Tests have shown this detector to be about as sensitive as the ordinary steel-carbon detector. It possesses the important advantages for shipboard use of durability and simplicity; also that its operation is not affected by jarring. It is practically interchangeable with the electrolytic detector as regards tuning.

The audion, which was recently described in these columns (ELECTRICAL REVIEW, November 3, 1906), is based upon the Elster and Geitel tube arrangement for showing the ionization of a gas by means of an incandescent filament. To this arrangement De Forest adds a flux battery in an external circuit in which is placed a telephone receiver. In-coming electric oscillations apparently affect the equilibrium of the circuit and thus produce sounds in the telephone.

The Pickard silicon detector belongs to the thermo-electric class of receivers. The electrodes employed are pure silicon and a metallic element of low resistance. The energy of the receiver oscillations is converted into joulean heat at the element having high resistance and high thermo-electromotive force, which heat is converted at the contact into a short pulse of direct current in the telephone receiver.

Mr. Pickard has made numerous tests by means of specially devised apparatus to determine the sensitiveness of various detectors. (See ELECTRICAL REVIEW, December 15, 1906.) These tests show that the silicon detector is practically of the same order of sensitiveness as the electrolytic and magnetic detectors.

Another reported improvement in wireless telegraphy that may eventually lead to important results is the employment of undamped or persistent oscillations at the transmitting stations. Poulsen, the inventor of the telegraphone that bears his name, is accredited with having made notable advances in this direction by a modification of the Duddell singing arc. (ELECTRICAL REVIEW, December 8, 1906.)

In Poulsen's device the positive electrode is copper, the negative electrode is carbon; the arc being produced in a closed box. The copper electrode is in the shape of a ring through which water is passed for cooling purposes. It is claimed that tests have demonstrated that by this method of setting up undamped oscillations, signalling greater distances with a much reduced expenditure of energy as compared with the spark method is obtainable.

It appears that the singing arc has already been employed in practice by the Telefunken company at their powerful station in Nauen, about twelve miles from Berlin. In this case, however, the arc is used in the ordinary atmosphere. The electrodes employed are copper and carbon. For cooling purposes the copper electrode is made in the shape of a cup filled with water and having a concave bottom, the carbon projecting into the cavity. The results of the experience with this type of oscillator at Nauen indicates that it will be difficult to maintain constant conditions at the arc, hence the frequency of the oscillations will be variable, a state of affairs which would be detrimental to sharply tuned systems. Another possible objection to this form of oscillator is that the energy output is comparatively small, much less than that obtainable with the spark. It remains to be seen whether greater uniformity of the oscillations, by permitting a better utilization of resonance at the receivers, will compensate for the lower energy output.

Still another method of obtaining undamped oscillations has been patented by S. G. Brown, London, England. This consists of a slowly moving metal disc, preferably aluminum, upon which a balanced block of copper loosely rests. This moving contact is shunted by an inductance and a capacity. When a direct current of 200 volts is passed through the moving contact, in series with a resistance and an inductance coil, exceedingly rapid oscillations of the order of over one million per second are set up in the condenser circuit shunting the moving contact. (See ELECTRICAL REVIEW, December 15.)

This method of obtaining non-damped oscillations is to be employed in the Hozier-Brown Radio Telegraph Company.

Thus far but little progress has been made towards obtaining successful transmission of radio-telegraph signals in one direction only, and every wireless station continues to emit its electric radiations in all directions. During the past year Marconi and Braun have published the results of some experiments which they have made independently to confine the radiations of electric waves to one direction. Marconi's tests, which were described in the ELECTRICAL REVIEW, May 26, 1906, were made with horizontal wires. He found that the maximum effects were obtained when the end of the horizontal wire connected with the receiver pointed towards the transmitting station.

Braun, in his experiments, proceeded on the theory that since electric waves are amenable to the same laws as light waves, it should be possible to direct electric waves by means of a parabolic reflector. But realizing the practical difficulties in the way of procuring a suitable reflector of this type it occurred to him that the same result might be reached by an arrangement of the transmitting wires whereby the intensity of the wave could be increased in one direction and decreased in another direction. To this end he constructed a station of three wooden masts arranged at the corners of an equilateral triangle, upon each of which masts a wire was erected, and from the lower point of which a connecting wire was carried to the transmitter. By setting up oscillations of equal phase in two of the wires and an oscillation of equal frequency, but which lagged or led in phase the oscillations of the other wires, interference between it and the other wires follows, and the equivalent of a shadow or an amplified wave in a given direction is thereby obtainable. (ELECTRICAL REVIEW, September 16, 1905.)

The expected international conference on wireless telegraphy was held in Berlin last October and closed its sessions on November 1. Many of the articles of the protocol covering the subjects to be considered by the conference were acted upon favorably. Among these is the article making it obligatory for coast stations and stations on ship-board to interchange telegrams regardless of the system of telegraphy employed. It was also decided that all stations are to be organized as far as possible to prevent interference with other stations. The article providing that messages of distress shall have priority over all other messages was adopted unanimously. Action was taken also looking to the establishment of a bureau to which all matters pertaining to international wireless telegraphy shall be referred—similar to the international bureau governing land and cable telegraphs at Berne, Switzerland. The article proposed by the delegates representing the United States making it obligatory upon ships to interchange messages of whatever nature without regard to the type of apparatus employed on ship-board, was not accepted by Great Britain, Italy, Japan, Mexico, Persia and Portugal.

Perhaps one of the most notable actions of the conference was the unanimous adoption of a term to designate more fittingly wireless telegraphy, namely raido-telegraphy. Hence future international conferences of this nature will be

known as radio-telegraph conferences, and doubtless the term will be very generally adopted, inasmuch as it is a more appropriate term than wireless telegraphy, which from the first has been recognized as a misnomer.

We appear to be as far from the practical realization of trans-Atlantic radio-telegraphy to-day as was the case in 1901 when the consummation of this service within a few months was confidently predicted. Indeed the results of the long continued experiments recently conducted by Fessenden between Machrihanish, Scotland, and Brant Rock, Mass., so far as they have been published, indicate that the inherent difficulties of telegraphing continuously over very long distances are at present practically insurmountable.

For short distances, however, the expansion of radio-telegraphy has been very marked during the past year, and it is now almost impossible to accurately compute the number of wireless equipments in operation in all parts of the world. There are said to be 630 radio-telegraph plants of the Telefunken company, over 400 of the Marconi company and more than 180 of the De Forest company's sets in use in various parts of the world. There are besides in the aggregate many sets of the Lodge-Muirhead, the Fessenden, the Shoemaker, the Rochefort, the Stone, the Massie and other wireless systems in operation. All of these wireless outfits, it may be noted, are, with only sufficient exceptions to prove the rule, for use on ships and on shore stations. In short, radio-telegraphy is rapidly filling the place which naturally belongs to it and which was assigned to it from its inception by all competent and disinterested persons, namely as a medium of communication between ship and ship and ship and shore.

British Electrical Progress in 1906.

By Albert H. Bridge.

THE visit to Great Britain of the deputation of foreign electrical engineers who came at the invitation of the Institution of Electrical Engineers must have first mention, for it ranks as an event of first importance, affording as it did an opportunity for international electrical fraternizing and for fostering feelings of good fellowship among British, American and Continental electrical engineers which will bear good fruit for long years to come.

In regard to manufacturing and trading, we have to record an unsatisfactory year; not that the volume of business has been smaller than in the previous year, but, owing to a variety of causes, the margin of profit has been very small. Manufacturers have had to complain less of competition from foreign suppliers than of severe undercutting between themselves. Various suggestions have been made for ending this unfortunate state of affairs, and attempts have been made to bring leading firms together with a view to establishing and maintaining reasonable prices. As in other countries, advances have, of course, been made to meet the rise in cost of materials, but any agreement among British manufacturers of electrical machinery and supplies for a general advance in order to insure profits is difficult of realization. Cable manufacturers, it is true, have their own organization, and the makers of interior conduit materials have just come together and announced important advances. Perhaps during the coming year other sections may be brought into conference.

The municipal telephone movement may be fairly described as completely broken down by the events of the past year in this direction. The few cities and towns that had taken steps in this class of venture in competition with existing systems have welcomed opportunities that have arisen for their being relieved of these burdens by government purchase. It is not likely that new licenses will be sought.

London has had its electric power supply problem investigated by Parliament, but the matter is still in a quite unsettled state. The month of November saw the publication of many proposals which will be considered early in the new year, among them being the London County Council's ambitious project already described in the ELECTRICAL REVIEW: A proposed amalgamation of the existing companies and a new scheme by the administrative company.

The movement for popularizing the sale of electricity has been the most noteworthy feature of the year in the electricity supply department, and it gives every promise of becoming a very big affair. Commercial assistants or publicity managers are regarded as a necessity by any undertaking that desires to encourage the full use of electricity by the public. Big efforts are being made to do electric-heating business, and manufacturers of radiators, both of luminous and convector patterns, are experiencing rapidly increasing demands. Electric cooking appliances, too, are being pushed, but not yet with the same degree of success.

The attempt to introduce a system of electric omnibuses in London and the provinces was, on various grounds, made the subject of considerable expert criticism in the electrical press, and the company concerned has been, so far, busily engaged in litigatory matters due to large numbers of its shareholders applying for the return of their money and the removal of their names from the lists. It is said, however, that the company is going ahead with its plans, employing the capital of those who remain on its share register.

The Metropolitan District Railway is now working smoothly with 198 motor-cars and 232 trailers. The train-miles run during the half year ended with June showed an increase of 19.6 per cent as compared with steam operation. As regards cost of working, with steam it was 24.38 pence per train-mile, and with electricity 21.05 pence.

The new tube line between Baker street and Waterloo was opened during the year, and the Great Northern, Piccadilly & Brompton tube has also been completed.

The Great Western completed its power station at Park Royal, from which energy is obtained for working the Hammersmith & City line proper, also certain lines between Bishop's Road and Westbourne Park, and a branch railway.

The Northeastern Railway's experience with direct-current electric traction in the Newcastle district has continued satisfactory, but no definite action appears to have been taken in regard to the extension of electrification to other parts of the system. A service of petrol-electric cars is in operation for certain districts. It was announced during the year that on its thirty-one miles of suburban electric railway the Northeastern had practically doubled the train mileage and doubled the accommodation to the public as compared with steam conditions. Smaller trains, but more of them, were run, and the running cost per train-mile, allowing for depreciation of stock, etc., had been with electricity about nine pence, as compared with one

shilling and five and one-half pence under steam conditions.

The Lancashire & Yorkshire Railway during the year coupled up its electric system with the Liverpool Overhead Railway at Seaforth. Through cars were run from Southport to Dingle, new cars of specially light construction being introduced for the purpose, owing to the exceptionally light structure over which the overhead railway travels. Two-car trains arranged on the multiple-unit system are used. The Lancashire & Yorkshire has made further progress with its electrification since then by proceeding with the conversion of all four lines between Bank Hall and Seaforth, two lines being reserved for fast traffic.

By no means the least important railway development of the year has been the adoption of the single-phase alternating-current system for the London, Brighton & South Coast Railway's lines between London Bridge and Battersea, and for the Heysham section of the Midland Railway.

The most important work done in the direction of street railways has been in the London area. The conversion of many miles of horse line to electrical conduit has been pushed forward by the London County Council, and work is now in full swing on its northern lines. The London United Tramway Company has been proceeding with the important extensions which connect its West London trolley lines with Kingston and Surbiton, in Surrey. When the company's extensions to Wimbledon and Tooting are finished its total route mileage will be fifty and one-half miles. The Middlesex County Council has also been equipping trolley lines, while the Metropolitan Electric Tramways Company, Limited, has been completing similar lines, which meet the London County Council conduit track at the northern end.

Considerable advance has been made with the application of regenerative tram-car control systems. The question of tram-car braking appliances has been very much to the fore. A series of serious accidents led to a thorough investigation of the position by the Board of Trade, and a lengthy report by Colonel Wilfred Yorke, in which he suggested that the representative tramway organizations or the Engineering Standards Committee should concern themselves seriously with the problems connected with street-car control. The London County Council has during the year adopted electromagnetic brakes for a large number of its conduit cars, as the Board of Trade had intimated that it would be prepared to increase the maximum speed if such brakes were adopted, according to the class of traffic in the different districts. Some headway has been made with the adoption of surface-contact systems for street traction. The Lincoln lines are operating on the "G. B." surface-contact method; the equipment of the Torquay and Musselburgh systems, on the Dolter principle, has been proceeding, and the Oxford city authorities have resolved to employ the Dolter method there. The Kingsland mechanical surface-contact system has been improved.

The Manchester corporation plunged all too recklessly into a big scheme for a parcels-carrying service in connection with its trolley system, and established so extensive an organization that local carriers fought the matter out in the courts. The decision went against the corporation just sufficiently to spoil its scheme, and the enterprise is now one of very limited proportions, and less than no profit.

The opening of the London County Council's big power station at Greenwich should be mentioned in this section, the station having been built for supplying the council's tramways.

The year's developments in connection with the big power-distribution schemes can not be reviewed with feelings of unmixed satisfaction. In March the South Wales Power Distribution Company's difficulties were made public. A big outlay had been incurred for stations, plant and mains, and only a comparatively small demand for power had arisen. Space will not admit of a recital of the troubles, but drastic changes were introduced and the latter months of the year have seen a serious attempt being made to place matters on a more satisfactory footing. The advice of C. H. Merz has been taken, and London financiers have come forward who are prepared to find $2,500,000 to help save what has already been spent if colliery owners and others in the district will guarantee a certain demand. In Lancashire, and in Yorkshire, too, where similar schemes have been carried through, there is a waiting for business, and the result is that shares of such concerns have been quite out of favor. No doubt, all will come right in time, but at the moment most of the power undertakings are under a cloud. The Tyneside operations are practically the only ones that have been really successful and here the results have been most satisfactory. Among other leading power events in this district has been the removal of one of the Castner-Kellner Alkali Company's departments from Runcorn to Tyneside, purely in order to take advantage of the cheap power supply available there. The Clyde Valley power scheme has got well to work, and the interesting 10,000-horse-power hydroelectric installation in North Wales has commenced operations and is supplying power to various large quarry owners and other consumers. The 10,000-horse-power plant of the Durham Collieries Electric Power Supply Company is also in operation. Over 20,000,000 units were said to be booked before the station was running.

The power supply developments led to the formation in April of a society of power company officials.

The new Summer Lane station at Birmingham was fully described in the ELECTRICAL REVIEW. The Brighton corporation opened its new generating station at Southwick, containing three 3,000-brake-horse-power Westinghouse turbo-alternator sets. The new station at Marylebone, to which reference was recently made, has been settling down to its work.

Manchester has been making excellent headway with its power supply and has been engaged upon an extension scheme for meeting a big demand from large engineering works, six of which alone require at least 10,000,000 units per annum.

There are now seventy-four electricity undertakings (municipal) in conjunction with which refuse destructors are working.

Several facts of consequence in connection with the use of electricity for train lighting have to be noted. The Board of Trade officials have, in reporting upon railway disasters, been most emphatic in their condemnation of gas lighting (as the cause of fires), and in their advocacy of electric lighting. The Leitner-Lucas train lighting system accomplished a remarkable achievement on the Great Western Railway which excited a good deal of interest. Other systems have been introduced during the year, one of them being known as the "Vickers-Hall."

The new electrical department was opened in June at the National Physical Laboratory at Bushy. The magnetic observatory has been constructing at Eskdalemuir, in Dumfriesshire, to take the place of the existing one at Kew, owing to the site of the latter becoming unsuitable because of the electric railway and other installations in the vicinity. A new electrochemical laboratory has just been added to Liverpool University; it is

named the Muspratt Laboratory of Physical and Electrical Chemistry.

Wireless telegraph matters have been constantly to the fore. The agreement between the Post Office and the Marconi company, the litigation between Marconi and Lloyds, the British action at the wireless conference at Berlin and the controversy connected with it; the work of De Forest, Poulsen, etc.—all these can only be hinted at. The most unfortunate feature is the collapse of the 450-foot tower of the National Electric Signalling Company, of Washington, at Machrihanish in Argyllshire, during a gale on December 5—the tubular steel structure which had been erected for the purpose of signalling to America.

The work of the Post Office in extending the underground telegraph cable system; the long-distance transmission work achieved with the Murray automatic telegraph system; the development that has been taking place in the use of electricity in steel works, cotton mills, and on ships (as instanced in the case of the Mauritania contract); the taking in hand of the big Loch Leven water-power utilization scheme of the British Aluminum Company; the great operations of the Post Office and of the National Company in the extension of telephony—all these form important features of the year's electrical developments in the United Kingdom. A very real progress, too, has been made in the use of electricity in coal mining. The seed sown during recent years is now bearing fruit. In coal-cutting, electricity is running compressed air somewhat close. The official return just issued shows that at the end of 1905 there were 446 electric coal-cutters in use as compared with 500 worked by compressed air. A year earlier the figures were 270 electric and 485 compressed-air machines. This shows that practically all the new work was electrical. Now that English and Scottish colliery officials are fully alive to the advantages attending electrical working, the 1906 figures should be more interesting when they are obtainable.

To attempt to cover the electrical work that has been proceeding in the British Colonies during the year would require an article in itself. The year closes with the six million-pound scheme for utilizing the Victoria Falls for power supply on the Rand and in Rhodesia loudly clamoring for public subscriptions.

Review of Electrical Progress in Europe.

By C. L. Durand.

THAT steam-turbine plants of large size are being erected on the Continent will be observed from the fact that the new St. Denis plant at Paris is to contain twelve turbine-alternator sets of 12,000 horse-power each. The wheels in this case are of the Brown-Boveri-Parsons type, and are coupled to 6,000-kilowatt alternators. At the St. Petersburg city lighting station the already existing steam-engine oufit has been increased by the addition of two Brown-Boveri turbines of 750 horse-power and the Geneva municipal plant is also using the same type of wheel. The Compagnie Française Thomson-Houston started to build the Curtis turbine in its Paris works and is beginning to supply them for many stations. Five Curtis turbine sets are erected at Tokio, coupled to 500-kilowatt alternators, and one has been delivered to the Allgemeine Elektricitats Gesellschaft, of Berlin. In the south of France the Risso plant, using the same turbines, has now 4,000 horse-power installed, and they are also in use at the large station owned by the Compagnie du Gaz et d'Electricité, of Nice. In Germany the Vereinigte Maschinenfabrich Augsburg-Nürnberg is going into the manufacture of the Zoelly turbine, and has now set up a number of units, among which are a 500-horse-power turbine-alternator set in the Neu-Essen mines, a similar group in the Mülhausen central plant, and a 1,500 horse-power set in the Bibi-Eybat plant at Baku. The Zoelly turbine is also manufactured by the Siemens-Schuckert Company.

The use of gas or petrol engines on the Continent is on the increase. It has been found that great economy can be secured from the new types of low-carbon gas engines which are designed to work upon the gas from blast-furnaces. The John Cockerill firm, of Belgium, is prominent in the construction of these engines, from 1,000 horse-power down, and in France the Cail company has gone into building the low-carbon gas engines, as there is a great field for their use. In France gas producers have been operated by waste fuel such as sawdust and shavings, and one such plant at the Beaume car shops is running several dynamos in this way. At Noisel experiments were made with waste farm products, and it was shown that current could easily be produced in this way. Among the gas motors the Körting holds a good place, and this firm has installed a number of electric plants in Germany, while the Pierson and the Otto makes are used in France. At Orleans a 500-horse-power gas-engine group is running, and a smaller set at Potiers. Heavy oil fuel is used in the Diesel motor, which is designed for running generators. As regards gasolene motors, a number of the leading firms are making these in stationary types. In general they are of the well-known design, such as is used on automobiles, but a decided improvement seems to be in the new Duplex motor, constructed at Paris by the Bourdreaux firm. By using a new principle they succeed in making a smaller motor for the same power, reducing the fuel consumption by twenty to thirty per cent, and the cost by forty per cent. Another recently patented motor is the Victoria, which has somewhat similar advantages.

In the Alpine region of the southeastern part of France has been erected a hydraulic plant on the Romanche river at Livet, which uses a 195-foot head of water and at present contains three turbine and alternator sets of 2,000 kilowatts each. Power is transmitted to the city of Grenoble. Farther south, in the mountainous region lying near the Mediterranean coast a number of plants have been erected within a recent period. Among these is the Entraygues station upon the Argens river, which contains three 1,000-horse-power groups and sends current at 28,000 volts to the city of Toulon, situated at forty miles' distance. Besides the new 8,000-horse-power plant at St. Cezaire, on the Siagne river, the Société Enérgie Electrique, which controls most of the stations in the region, is erecting a 14,000-horse-power plant on the Durance, at Brillianne-Villeneuve, which will be the largest so far built here, and also expects to put up a 20,000-horse-power station at Verdon. These stations supply Marseilles, Nice, Toulon and other coast towns. On the Tessin river, in the north of Italy, a newly erected station sends current to Milan, Pavia and other cities, and now contains five alternator sets of 1,500 horse-power.

The Brown-Boveri firm has erected a large station on the Cellina river for supplying the city of Venice. It uses a 200-foot head of water and has a total capacity of 15,000 horse-power. A second plant of the same capacity is to be erected. The Mont Cenis station, installed by the Thomson-Houston company, is now delivering a large amount of power to Turin over a 30,000-volt line. It is located on the Cenischia stream and contains three 1,700-horse-power sets. The hydraulic station of Rienz, in the Tyrol, may also be mentioned. It uses at present three 800-horse-power turbine-alternator sets and delivers current over a large area. At Freyung, in the south of Germany, a hydroelectric plant supplies current for a large carbide works, and uses a 250-foot head of water, giving about 5,000 horse-power for this purpose. Not long since, the Alioth company erected two large plants in the Lake Leman region at Hauterive and Montbovon, which are run in parallel on a large network, also supplying the La Gruyere electric railroad.

Among the direct-current, single-phase, or three-phase systems which are now in actual use or under trial for electric locomotives or large motor-cars may be noted the Ganz locomotives, which are now running upon the Lecco-Chiavenna Railroad in the north of Italy. Current from the Morbegno hydraulic plant at 20,000 volts is reduced to 3,000 volts, which is used upon the overhead trolley line. The three-phase locomotives are fitted with two Ganz motors of 400 horse-power each. A type of locomotive which has been recently designed and built is made by the Fr. Krizih firm, of Prague, and is intended to be used upon the city railroad system of Vienna, which runs part of the way in tunnel. Direct current is used in this case, as it is found the best for the conditions of operating the Vienna system, but an unusually high voltage is employed for the trolley wires, as it is run at 3,000 volts. There are four motors coupled in series upon this voltage, each motor working at 750 volts and giving 130 horse-power. The Westinghouse company is now running a single-phase road in Italy which connects Rome with Civita Castellana. Current is taken from an overhead trolley wire. In the suburbs of Paris the Compagnie Francaise Thomson-Houston is running a type of single-phase motor-car which is equipped on the Latour system. That three-phase locomotives can be run very successfully upon 3,000 volts is seen in the operation of the Simplon Tunnel plant. These locomotives, it will be remembered, use the Brown-Boveri system and take current from two overhead wires. No difficulty is found in running the trains, and a large amount of traffic is carried already.

During the past year the Paris Metropolitan road extended its lines by the addition of what is known as the southern branch, which makes a semi-circular tour through this part of town, connecting with the straight portion at two different points. It gives a rapid communication with the central district which is much appreciated by the public. Like the corresponding north section, the line runs part in tunnel and part on an overhead metallic structure. Trains are made up of a 750-volt motor-car and a number of double-bogie trailers of the same external type. Work on several new sections is being carried on rapidly. The next line to open will run directly across the above system from north to south. Where it crosses the Seine a number of large metallic caissons are being sunk which will form the subway at this point. In Germany a 900-volt direct-current line is now running from Bonn to Cologne, using 250-horse-power motor-cars. A twenty-five-mile road is operated between Montbovon and Palezieux (near Lake Leman). Another electric road in Switzerland connects Lausanne with the town of Moudon, using 750-volt motor-cars and trailers.

Electro-metallurgy has been developed considerably of late, and attempts are being made to bring the different electric furnace processes to a commercial scale, so as to develop the mineral resources in countries where, as in Italy, for instance, coal is scarce, while there is an abundance of hydraulic power. The Stassano process is now one of the farthest advanced on the Continent, and it is operated by the Italian government. At Gysinge, Sweden, the Kjellin process appears to be very successful in producing iron or steel, and it seems that about one thousand tons of steel were turned out during the year, using a 170-horse-power furnace. In France a plant is erected at Moutiers for the production of ferro-silicon. The Froges-Heroult is one of the new steel processes which is coming into view in France. A large plant to use it is now located at La Praz which gives an annual output of 4,000 tons. At Kortfors, Sweden, and at Remscheid, in Germany, have been erected electric furnace plants for iron or steel production, and the Saut Du Tarn plant in France will soon be in operation.

Electro-chemical processes have not been behindhand. Among these we may mention the Birkeland and Eyde arc furnace method for obtaining nitrogen or nitrous product from the air, and the most recent type of furnace uses a 500-kilowatt arc for this purpose. A new process has come out in Germany for the production of tetrachloride of carbon, consisting in acting by the electric arc on a mixture of coke, sand and salt, when the gas is given off and is condensed to a liquid. This body is used in the manufacture of phosphoric acid. There are now a number of carbide works in operation in France and Germany. In Italy the manufacture of carbide is on the increase, and soda is another product which is now turned out in large quantities. At Barcena, in the north of Spain, a large hydroelectric plant is erected for the electrolytic soda process, with a total capacity of 1,500 horse-power.

As to the progress of arc and incandescent lighting during the recent period, we find that while the use of the standard types has been on the increase in the principal cities of the Continent, there is nothing of special interest to report in this direction, except that the improvements which are made in the burners of the Welsbach type give a serious competition to the incandescent lamp, especially in countries like France, Italy and Spain, where coal is dear, and the public is quick to appreciate any economy in the already high price of current coming from steam plants. It is expected that the new metallic filaments will be a great step in advance in this direction. Most of the work upon these is done in Germany, but at present the tantalum lamps are introduced upon the market in France, and their low consumption, about one watt per candle, will no doubt lead to their adoption before long. The mercury-vapor lamp is also making its appearance for private lighting. It attracted a great deal of attention at the Paris automobile show, where there were a number of lamps placed in the centre of the great dome and elsewhere, and, added to the 80,000 incandescent lamps of the building, gave a good effect.

In the field of radio-telegraphy we find that a great advance has been made during the past year, especially in Germany and France. The Telefunken Gesselschaft, of Berlin, is bringing out improved apparatus, and has now erected some of the most important stations on the Continent. One of these is located, as will be remembered, at Nauen, near Berlin, and consists of a metallic tower some 350 feet high, with a set of wires running down to the ground. It can operate at present as far as 1,500 miles, and sends messages to vessels on the Atlantic. The

Norddeich station, in the north of Germany, has been very successful in sending signals to vessels in the North Sea, and can operate for 1,200 miles, but soon expects to increase the distance. In France a station has been in operation for some time upon the Eiffel Tower, and from here messages are sent to the eastern frontier towns and also to the Mediterranean coast. Professor Branly's system is in use by the Popp-Branly company. As the government controls the operations in France, private companies have but little advantage here, so that they are obliged to seek other fields. For instance, this company has been successful in Roumania, where it secured the government contract for erecting the large Costanza post and fitting out some of the war vessels. The Thomson-Houston company has lately taken up the manufacture of apparatus, and has erected several posts in Germany and Italy. One of the most recent posts in Switzerland is established on the high point of the Righi-Scheidegg, and communicates with the neighboring plants. On the Austrian coast, at Fiumè, is erected a station on the Hallos system for signalling to vessels or to the islands. The Berlin conference has been one of the leading events of the year in radio-telegraphy, but the different nations represented had some difficulty in coming to any kind of a satisfactory agreement. In West Africa a system of military signalling is in use in which the wires are suspended from small balloons, and messages can now be sent for 270 miles or more. Train signalling is being tried on the Bavarian railroads, with some success.

Electrical Patents in 1906.

By E. G. Siggers.

THE patent situation during the past year has, to state it briefly, gone from bad to worse. In considering this statement, however, the distinction between "inventions" and "patents" must be kept clearly in mind, for never before in the history of this country, nor for that matter in the history of the world, has there been such a wealth of inventive genius displayed, such wonderful achievements and so many apparently insurmountable obstacles overcome. And it is this same wonderful development in the world of invention that is partly the cause of the present condition in the patent situation.

To completely comprehend this, it is necessary to look into the history of patent grants. Originally they were merely matters of royal favor, and, for example, in England, up to within a short time, any one applying was granted a patent without an examination as to whether or not the invention was old. It will be evident that such practice was no particular incentive to inventors, for a wealthy manufacturer could readily make application and secure a patent on a meritorious invention already patented by some poor inventor, and, through the latter's inability to protect his rights because of the expense of litigation, the manufacturer could ignore such rights. It was this country that hit upon the proper theory of patents by causing examinations to be made in order to ascertain the novelty of an invention prior to the grant of the patent. With this warrant of the *prima facie* validity of a patent, an inventor can approach a manufacturer and treat with him on equal ground, knowing that if the latter should attempt to secure protection in his own name on the invention, he will be met with a rejection on the patent already granted. Thus the government to a certain extent is back of the patent, though, of course, if it can be shown that the invention covered thereby is old, the patent is invalid. This is the American practice, and is being adopted with some modifications by all the leading nations of the world. It is a practice that has established this country as the leader in all lines of mechanical activity, and is undoubtedly responsible, to a great extent, for the material wealth with which we are blessed.

As a result, the patent-granting branch of the government has grown from a beginning wherein the president and cabinet personally passed on the merits of each invention to a bureau of considerable magnitude presided over by a commissioner of patents and a corps of examiners, clerks and assistants. But this growth has entirely failed to keep pace with the rapid advance in the number of inventions, and as a consequence there is a vast accumulation of work, a lack of force to do it, and cramped and inadequate quarters, so that conditions in the Patent Office have become intolerable. Every year adds thousands of patents, foreign and domestic, thousands of pamphlets, catalogues and literature concerning disclosures of devices not patented. These should all be digested, classified and examined before patents are granted; for it makes no difference where an anticipation is found—if an invention is not new, a patent should not be granted thereon. Under present conditions, therefore, a complete examination is impossible, and even making examinations as best the examiners can, the Patent Office is months behind in its work. The result is that the *prima facie* validity of patents must constantly and necessarily be sinking to a lower and lower plane, with a corresponding decrease in their *prima facie* value. Moreover, inventors are becoming discouraged, because of their inability to secure, within a reasonable time, the protection to which they are entitled under the law.

Another and very fruitful source of embarrassment to the Patent Office is its inability to obtain and retain competent assistants in the examining corps. The salaries vary from $1,200 to $1,800. Young men, college graduates usually, pass the required examination, and are appointed. They come in, absolutely ignorant of the first principles of patents, patent law or patent practice. Their knowledge, in so far as the work in the Patent Office is concerned, is practically nil. It requires several years to become experts in these matters, and become acquainted with the particular classes of invention which they are called upon to consider. This latter fact will be self-evident to any one having the most superficial knowledge of any involved art, as for instance, telephony, telegraphy, electric lighting in all its phases, or electrical generation, distribution and motive power. It requires as much time to become conversant with patent practice and patent law. The majority of these young men, however, have a comfortable income for their present needs, are learning patent matters and patent law in the daytime while at the office, and occupy their evenings with the study of law, for Washington is well equipped in this respect, inasmuch as a number of law schools have evening sessions for the benefit of departmental employés. In three or four years these examiners become graduates in law, and having obtained sufficient knowledge in a particular art, besides having become more or less proficient in patent law, they resign, and become associated with or employed by patent attorneys, manufacturing corporations or the like, where the com-

pensation is greater and the prospects brighter. The Patent Office then has to break in new and totally unskilled assistants in their places, resulting in still more confusion and greater arrearage. Thus the Patent Office is being employed to a great extent as a school, for which the public pays and for which it suffers. As instances of this, the personnel of one of the electrical divisions of the Patent Office has completely changed twice, with the exception of the principal, within the last four years, and in another electrical division there has been a resignation on an average of every two months for over a year. Moreover, there is a constant pressure for positions in these electrical divisions because of the chances for advantageous offers outside the office.

The fault, or rather the remedy, for these deplorable conditions unquestionably lies with Congress, which has heretofore been anything but liberal in its treatment of the Patent Office. While hundreds of millions are being spent on agriculture, on the army and on the navy, which bring in absolutely nothing from a material standpoint, the Patent Office, the only self-sustaining government institution in the country, is given barely enough respect to keep it in existence, and is compelled to turn into the treasury every year whatever surplus it may have over its expenditures, which surplus usually amounts to about $250,000. That this is not just will be evident to any one. The bureau of the government that has brought wealth and prosperity to this country should not thus be set aside. Nor can it be argued that the hundreds of millions are given and spent by the department of agriculture and the army and navy because of their greater importance as instruments in the production of such wealth and prosperity, for the answer to such a statement is that without the American inventor the country's crops could never be raised and handled, its natural resources could not have been developed, nor could we have had the modern equipments of our army and navy in all their multitudinous details. It has been suggested that this glaring discrepancy in treatment is due to the fact that the Patent Office, in its very nature, is placed outside the pale of political activity; but whatever may be the real reason, it is clear that, for the welfare of the country, an office should be provided that is sufficient for all the needs, that a competent and adequate force should be employed to handle the work and that salaries should be paid which would insure the employment and retention of experts in the various lines of invention and in patent law and practice.

The Automatic Electric Company.

The Automatic Electric Company has enjoyed the busiest and most prosperous year of its existence. At present there are nearly $7,000,000 worth of orders on hand to be filled. These include some large plants, Denver, Omaha, San Francisco and Chicago being among the number. So enormous has been the growth of the business that the factory has been more than doubled in size and trebled in capacity. The new addition will be available shortly, and the enlargement will enable the company to cope with the constantly increasing demands for automatic equipment.

During the past year the Automatic Electric Company issued and sold the last $1,000,000 of its $5,000,000 capital stock, to provide additional working capital for its increased business.

Perhaps the most important contract which the company will handle this coming year will be for the 100,000 line exchange to be built in Chicago by the Independent Telephone Company, of Chicago, a $10,000,000 corporation, which has been formed by some of the leading financiers in the independent movement. This company has taken over the telephone rights of the Illinois Tunnel Company, the growth of whose automatic plant, serving the loop district only, has been retarded by reason of the fact that the latter company has devoted its entire capital and energy to the completion and perfection of its tunnel system for freight and mail service. The new independent telephone company for Chicago is an assured fact, and within a few years the city will be fully equipped for automatic telephone service.

In line with the new independent company's advent into Chicago are the arrangements for the entrance of the Independent toll lines. The South Bend Home Telephone Company, of South Bend, Ind., has been purchased by a company of independents, who will make that city the clearing point for the independent toll line business of that half of the United States lying east of that meridian. Similar arrangements will be made for the western and northern territory, and the completion of the work laid out will mark a great advance in the independent movement, both local and long distance.

The greatest development of the automatic business the past year has been on the Pacific Coast, where the system has been adopted by practically every city of importance from San Diego, on the southern end of California, to Bellingham, Wash., on Puget Sound, and a stone's throw from the Canadian boundary. Contracts have been made during the past year for automatic plants at San Francisco and Oakland in California (as well as large additions to the Los Angeles automatic system), at Portland, Oregon, and at Spokane, Tacoma, Bellingham and Walla Walla, Wash.

The Yale & Towne Plan of Raising Wages.

Henry R. Towne, president of the Yale & Towne Manufacturing Company, Stamford, Ct., at a meeting of its superintendents and foremen held recently, made announcement of an increase of wages and piece-rates of its 3,000 employés which is of much interest.

Each individual rate will be reviewed, and, where necessary, adjusted, due allowance being made for advances which have already occurred since December 1, 1905. The latter aggregate about $45,000 per annum, and those now proposed will aggregate approximately $75,000, making a grand total of $120,000 per annum to be distributed among the employés by changes in day-rates and piece-rates.

This action is voluntary on the part of the company, and is intended to recognize the industrial conditions now prevailing. The company aims always to pay rates which are at least as high as those generally current for each class of labor, skilled and unskilled, and believes that its liberal policy in these respects is appreciated and will result in increased efficiency, and, therefore, in better economy. It proposes to ascertain in this way if the policy thus indicated constitutes "good business."

International Exposition of Safety Devices.

Space is now being assigned for the exhibits of the first international exposition of safety devices, to be held at the American Museum of Natural History, New York city, from January 29 to February 12, 1907. The exhibits will include safety devices for wood and metal-working machinery, stamping, grinding and polishing machines, safeguards for boilers, elevators, windlasses, cranes and hoisting machinery, textile and building trades, safety lamps and explosives, quarrying and agriculture, chemical industries, safety from fire, railway and trolley safety.

The director of the exposition is W. H. Tolman, 287 Fourth avenue, New York city.

Central Station Accounting.

The subject of central station accounting is being actively taken up by the National Electric Light Association, and a committee has been appointed by President Williams to report at the 1907 convention of the association. The members of this committee are H. M. Edwards, New York Edison Company, chairman; A. S. Knight, Boston Edison Company; G. W. Curran, United Gas Improvement Company, Philadelphia; C. N. Jelliffe, American Light and Traction Company, New York, and Paul R. Jones, of Henry L. Doherty & Company.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Electrically Driven Marine Dredge Thor.

A description is given here by W. Miners of the German marine dredge Thor, the machinery of which is driven by electric motors. The dredge will remove hourly 220 cubic yards of material from a depth of twenty-five feet. It has a speed of about seven miles an hour and is about 150 feet in length. The machinery consists of two fire-tube boilers furnishing steam to two marine engines which may be used either for driving the vessel's propeller or for two centrifugal pumps. These engines are rated at 175 horse-power each. There is a third steam engine rated at 220 horse-power, 350 revolutions per minute, driving directly on one side an eighty-two-kilowatt, direct-current dynamo with a voltage ranging from ten to 110; and on the other side a forty-six-kilowatt dynamo for 110 volts. A fourth machine, rated at twenty-five horse-power, 500 revolutions per minute, drives a twelve-and-one-half-kilowatt, 120-volt generator. This machine is intended primarily for lighting, the other two being used for operating the various motors on the vessel. There is a common condenser for all four engines. The three generators are all four-pole machines and were furnished by the Schuckert Company. All of the apparatus on the vessel is driven by electric motors. This includes capstans of various types, jib cranes, as well as the dredging machinery itself. Power is supplied to the motors from independent switchboards, there being one switchboard for each generator; but arrangements are provided for cutting all of the generators in parallel if desired. The dredge is of the chain-bucket type, and is driven by a 100-horse-power motor. The speed of the former is controlled by varying the voltage applied to the armature, the generator for this purpose being separately excited. The controlling apparatus for steering the vessel and for operating the dredge is placed in the pilot-house, where it is under the control of one person. In this way the number of attendants required to work the vessel is reduced to a minimum.—*Translated and abstracted from Elektrotechnische Zeitschrift* (*Berlin*), *December* 20.

Radiotelegraphy on the Telefunken System.

In this series of articles a general description of the Telefunken system of radiotelegraphy is being given. The present section describes different types of antennæ employed and the sending apparatus. The antenna is arranged in various ways, one being in fan form, a number of nearly vertical wires being suspended from a cable held between two masts. At the bottom they are brought together and carried into the house. Another type of antenna consists of a number of horizontal wires suspended between yards on masts, vertical wires being carried down from the centre of the other wires. The third type consists of a number of loops of wire attached at the top and bottom of a mast. Other wires fastened to the centre of these wires draw them out from the mast, so that the whole arrangement resembles the frame of an umbrella partially opened. Fan antennæ, or the type first described, are considered suitable for the emission of waves of short length. The umbrella is suitable for portable military stations. The capacity of this antenna may be increased by making the angle of the umbrella more obtuse, so that the whole system, acting together with the earth, forms a condenser. This arrangement gives longer waves than the fan type. The T type of antenna referred to above is intended for ship installations. The capacity is concentrated in the horizontal system of wires. Although it is desirable in all of these antennæ to secure a good earth connection, this is frequently incompatible with strong, firm mechanical foundations. This is particularly true in the aerials if the towers are of great height; hence it becomes customary to insulate the antenna and connect its lower terminals to what is called the counter-capacity—a system of insulated wires spread upon the ground and buried in it. This counter-capacity forms the upper half of the condenser, the lower half of which is supposed to be the earth at the depth to which the ground water reaches. This system of earthing has been used with the idea of decreasing the resistance of the ground near the mast. In this system the receivers are loosely coupled, as a rule, because this facilitates exact tuning. Small stations with but one attendant are fitted with a telephone in combination with an electrolytic cell, a coherer and a Morse writer. In large stations both of these receivers are coupled in series for combined or separate use. It is said that the wave-length of foreign stations can easily be ascertained within three per cent by the Telefunken receiving apparatus, and that the system can easily change its wave-length within a range of from 600 to 3,000 feet without much detriment to the intensity of the signals. If a disturbing station be near the station with which communication is desired and the waves are equally powerful, a difference in wave-length of from four to five per cent must be resorted to to secure selectivity.—*Abstracted from Engineering* (*London*), *December* 21.

Trials on Suction Gas Plants.

A series of tests was carried out recently by Captain H. R. Sankey for the Royal Agricultural Society, of England, at the Darby meeting of the society in 1906. A review of this work is given here. He was assisted by Professor W. E. Dalby. The object of the trials was to determine, so far as a series of tests extending over one week would permit, whether suction gas can be relied on for agricultural work day in and day out, with the same degree of freedom from breakdowns as a steam engine, and with the same amount of attendance as is required by an oil engine. Satisfactory answers to these questions would prove the suitability of such plants for agricultural purposes, as there is no doubt of the improvement in fuel economy as compared with either the steam or oil engines of the same power. The size of the plant fixed upon for the trial was from fifteen to twenty brake-horse-power, which is suitable for threshing and other agricultural work. The points to which special attention was directed were attendance necessary, general design, including facility for cleaning and space occupied, regularity of working, fuel consumption, water consumption, price, relative proportions of gas producer and engine, and the volume swept by the piston relative to the brake-horse-power. A number of plants were tested, and of these three were selected as being the best. Figures for the performance of these three are given in tabular

form. A point also investigated was the risk of poisoning from the carbon monoxide produced in the producers. There is thought to be but little risk from this cause, since the pressure in the producer when the engine is at work is below that of the atmosphere, so that there is no chance for leakage. When starting, however, the pressure within the producer may be slightly above the atmosphere, particularly when a blower is used for bringing up the fire. For this reason the producer should be furnished with an outlet pipe carried through the roof of the building. When this is done there is little risk of poisoning. In the care of the producer the principal thing is to keep the fire fresh and clean. The following fuel and water consumption may be expected when working continuously: With anthracite coal at full load, 1.1 pounds per brake-horse-power-hour, including the fuel needed for starting and for banking during the night; at half load, 1.6 pounds per brake-horse-power-hour, including the fuel for starting and banking. The water required is one gallon per brake-horse-power-hour at full load, and three-quarters of a gallon at half load. Using coke as the fuel, the consumption is 1.3 pounds per brake-horse-power-hour, including the fuel needed for starting, and the water required is one and one-half gallons. The following deductions are made from the trials: Assuming a twenty-brake-horse-power plant to start on Monday morning with an empty producer, and run ten hours per day on full load for a week, banking the fires at night, the consumption of anthracite pea coal would be one-half ton per week and about three-eighths of a ton if the average load is one-half full load. The coke consumption is about twenty per cent more. From 2,000 to 3,000 gallons of water per week are required for a plant of this size. This is for cooling and for the scrubber. Of the plants tested, nearly all were governed by the "hit-and-miss" principle. From the trials it is concluded that there can be no reasonable doubt that with due care any of the suction gas-producer plants which were submitted for the trials will be satisfactory. Although less manual labor is required than in the case of a steam engine, more intelligent care is necessary to insure the production of gas of good quality. The attendance is less than will be necessary for a steam engine and boiler, and is not sensibly greater than what is needed by an oil engine of the same power. The duration of the trials is thought to be insufficient to warrant a definite opinion regarding the reliability of the different producers. One of the plants tested had been in continuous operation for three months, and upon examination the producer was found to be clean and almost free from clinker.—*Abstracted from the Engineering Times (London), December 20.*

Electrical Haulage on the Canal D'Aire et de la Deule at Douai, France.

One of the most extensive applications of electricity to hauling barges along a canal has been made near Douai, France, on the canals maintained by the French government. This system of canals has an average width of sixty-three feet and a depth of seven and one-half. The barges are sixteen feet wide, 117 feet long and carry a load of 290 tons with a draught of five feet ten inches. The ratio of barge section to canal section is unusually high. On account of this the tractive effort per ton required to attain a certain speed is greater, amounting in this case to three pounds per ton at a speed of 1.9 miles per hour. This speed is the maximum at which loaded barges are permitted to travel on the canal. The actual length of canal which has been equipped with electric haulage is thirty-five miles. Part of this has been in operation since 1897. On this the Denèfle tricycle is still in use. Although the electric haulage company has not a monopoly of the haulage on the canals, ninety per cent of the traffic is moved in this way. Occasionally horses are seen or steam tugs. The tricycle used on part of the canal weighs two and one-half tons, and has an efficiency of only forty-two per cent. On the sections of the canal where this is used the tow-path is in exceedingly bad condition, so that upsets of the tricycle are not unusual. Within the last year a considerable length of tow-path has been equipped with a light railway track, on which locomotives run, taking the place of the tricycles. In this way a considerable economy in power has been effected, as that required to haul the tractor alone is less than two kilowatts, and that taken by the tricycle is thirteen. The locomotive is simply and cheaply constructed. It is carried on two axles, the body being made of iron. Each axle is driven by a twenty-horse-power motor through double-reduction spur gearing. The distance between centres is five feet seven inches. The wheels are twenty-seven and one-half inches in diameter. The cabin is situated in the centre of the locomotive, where control of the ordinary series-parallel type is placed. The starting resistance, as well as the supplementary switches for lighting circuits, etc., are also placed within the cab. No effort has been made to build a light tractor, and to increase the adhesion a large iron weight has been built into the floor of the cab. The normal running position of the controller is with the two motors in series. This takes about twenty amperes at a supply pressure of 500 volts. The motors thus run normally at about one-quarter of their rating, but this load is continuous. The parallel position of the controllers is used only when the locomotive is not hauling a barge. The locomotive is run in either direction, and as there is but a single track, they exchange barges and reverse their direction of travel when they meet. The tow ropes are fixed to the cab about five feet above the rail, no special towing mast being employed. Current is collected by means of a trolley attached to a flexible cable. This is the arrangement which is used for the tricycles, and has been adopted for the locomotives, as it does not necessitate any change in the line. The return circuit is through the rails, which are bonded, and through the canal, which is said to give a much better path. The barges are fitted with towing masts about thirty feet high, which can be raised or lowered to enable them to pass when they meet. Power is supplied from four small generating stations, each feeding a section about nine miles in length. Power is used along the canal for operating the capstans which haul the barges through the locks. The locks themselves are operated hydraulically. The arrangement of four small generating stations does not conduce to economy, and it is planned to replace these by one large station where three-phase current will be produced at 26,000 volts and supplied to motor-generators at the substations. The cost of equipment was not great, being about $6,000 per mile, that of the locomotives being $1,600. To prevent the locomotives from being tipped into the canal, as happened occasionally with the tricycles, the rail next to the canal is 1.6 inches higher than the other.—*Abstracted from the Electrician (London), December 21.*

Reception by the Dayton Lighting Company.

The Dayton Lighting Company, of Dayton, Ohio, is one of the most progressive central stations in the country. Under the management of F. M. Tait many improvements and enlargements in its station and offices have been made. The company believes in publicity, and on the afternoon and evening of Saturday, January 5, received the citizens of the town at its East Fourth Street Station.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Follow-up Advertising for Central Stations.

The basic underlying principle of follow-up advertising is "stick-to-itiveness."

And, pray, why not?

The fundamental idea is based on the fact that the entire list to which such advertising is directed is composed of possible prospects, to a man.

Even customers—nay, particularly customers!

EXAMPLES OF CURRENT FOLLOW-UP LITERATURE.

So long as this be true, it would be rank folly to weaken, or let up, until such time as every last name in the list is placed on the debit side of the ledger, or it is proven that the name is hopelessly infertile.

And that is a hard thing to prove, because a prospect who turns a deaf ear to your appeals, month after month, for a whole year, may take heed and become a valued customer some time during the next year, provided he is solicited regularly and persistently.

In a breath, the advocate of the follow-up system of advertising works on the supposition that every name on his list is a "live one."

The right word, the right sentence, the right argument is needed to win these people.

And, furthermore, the right word for some is the wrong word for others.

Human nature is diversified.

Different people have different tastes.

The same arguments will not appeal to all alike.

Therefore, the necessity of formulating and conducting a follow-up system, covering an extended period of time, in order to give the opportunity for all sorts of arguments, in all sorts of styles, to appeal to all sorts of natures, at all sorts of moments, until we happen to strike just the psychological moment for each person.

While the follow-up plan is well fitted to go out and discover new and direct business of itself, it should perfectly aim to work hand in hand with your well-drilled solicitors and the local daily newspapers.

A proper follow-up does not consist of a succession of rambling, disjointed appeals, sent out spasmodically, or whenever you happen to have the time to attend to the matter.

As before hinted, the daily newspapers should be brought into commission.

It will not only tend toward a friendly attitude on the part of the press, but will pave the way for a favorable reception of your follow-up.

The good-will of the newspapers and the daily intimacy of their readers with your advertisements in these newspapers will go a long way toward securing favorable consideration, and, in this way, your follow-up will gain an unbiassed, fair reception, where otherwise, without the aid of the daily papers, it might be required to do the double work of first destroying certain prejudices, and then convincing the public.

The wisest plan is to prepare the follow-up system beforehand, "in a bunch," as it were, and always with a careful regard to local conditions, such as the attitude of the press and the public, the classes of business or people you have to do with, the system of light or power prevailing in your city, etc., etc.

It is really in the planning that the follow-up succeeds or fails.

After the proper planning, all that remains to worry about is to see that the advertising is mailed out regularly and for a sufficiently long period, and that a system of checking resultant enquiries (correspondence, telephone or personal) is inaugurated, whereby all such enquiries are consigned to the care of the proper solicitors for them to nurse and make the most of.

Too much stress can not be laid on the importance of keeping solicitors alert and fervidly interested in the enquiries received.

So long as the primary object of the follow-up is to blaze the way for the personal work of the solicitors, their interest should be kept at white heat, for every enquiry comes, logically, from a prospect who has been aroused by the preceding advertising, and who is half convinced before he writes in.

But after all is said and done, it mostly depends on the character of the follow-up—its plan, its arguments, its regularity, its persistency.

If you make your arguments strong enough, often enough, reasonable enough, the business will come, because no set of people can forever hold out against the hard truth, driven home regularly, forcibly and persistently.

Under this heading we shall, from week to week, present to our readers a little series of inspirational aphorisms (original, aboriginal and selected), which will, we believe, prove stimulating and suggestive to those who are interested directly or indirectly in the sale of central station current.

The solicitor who owes $50 for roses needs a guardian more than a job.

"Don't be with the company on pay-

day, and against it all the rest of the week."

"Human knowledge is very short, and don't reach but a little ways, and even that ways is twilite; but faith lengthens out the road, and makes it light, so that we can see tew read the letterings on the mile stuns."

Have faith in electricity.

Be true to your faith and you'll be generously rewarded.

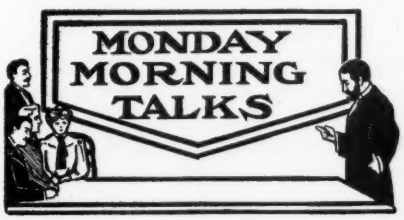
Truth handled with skill will accomplish more than falsehood.

Never misrepresent.

Interest your prospective customer in electricity, even if he says he won't buy.

Never pile up troubles for yourself.

The best way is usually the easiest.



Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.

We shall gratefully accept contributions and suggestions from any of our readers.

Well, boys—here we are again!

I was proud of you last week.

There was a bunch of nice work done, and we closed several good things.

Now, I want another week just like that.

I mean the same kind of spirit, the same "get-there" feeling in the atmosphere.

Give me a crew of fellows like you feeling that way and I don't give a rap about the results.

They'll take care of themselves.

There's one thing, though, that I want to kill the germ of right on the start.

I want you to eliminate this "Great I Am" talk that I've heard one or two of you doing.

It doesn't go worth a cent, gentlemen—it's rotten.

And I know you're sensible enough to see the point.

No one is more pleased than I am to hear of any of you landing business, but I fail to see why you should be so unbearably conceited about it when you do get a contract!

Why!—what else are you here for?

What would the company be paying you a salary for if you didn't occasionally walk in with some new business?

It isn't an occasion for a brass band and a reception every time a little contract is grabbed off!

It's just a part of the necessary operation of this company.

It's all in the day's work.

What would you think if, every time our bookkeeper added up a column of figures, he ran all over the place showing the result to everybody?

What would you think if our engineer down at the power-house came over here every day and made a big fuss because they'd kept his machinery running?

You'd say they were all going crazy.

Now, it's every bit as silly for you fellows to come lording it over everybody and pushing everybody off the sidewalk each time you get somebody's signature on the dotted line for some current supply.

For heaven's sake, let's cut this thing out.

Remember we're all working for the company.

We're the company.

Not Smith, Jones or McTavish, but the company.

And, when we land a contract, it's simply a case of company's business done, and not an occasion for personal hurrah!

Are you on?

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central-station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better than or different from the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

Address all communications to Charles A. Parker, care of the ELECTRICAL REVIEW.

There are many larger towns in the United States than Stafford, Kan., and there are many of these larger towns which do not begin to be as progressive electrically as this same Stafford, Kan.

The Larrabee Flour Mills Company, which furnishes electricity to the townspeople of Stafford, reports an extensive use of current in this little town of about 1,800 people.

Nearly all the better class of residences are connected up, and they are making preparations to go after some of the smaller residences, with every prospect of good success. One of the effective plans which has been adopted by this company for encouraging the use of electricity by people of small means is through the offer to wire dwellings on the installment plan, thus bringing the cost within the reach of the most modest householder. The minimum for residence lighting is $1 per month; for commercial lighting $1.50 per month.

W. J. HALL, CONTRACT AGENT FOR THE SOUTH BEND ELECTRIC COMPANY, SOUTH BEND, IND., IS ONE OF THE MOST AGGRESSIVE BUSINESS-GETTERS, AND HAS A WELL-TRAINED SOLICITING STAFF AT HIS COMMAND.

The Fremont Yaryan Company, of Fremont, Ohio, has recently fitted up a large new office next door to the principal bank.

The front room and full-size plate-glass window are used to display as nice a stock of electrical supplies as is to be seen in the state.

President T H. Jungk had placed in the window a beautiful Christmas tree equipped with an electric lighting outfit, making it by far the most showy office window in Fremont.

This Christmas tree remained a part of the window adornment all through the month of December.

The Kenosha Gas and Electric Company, of Kenosha, Wis., keeps up a full display of lights in its show windows all night 365 nights in the year, and directly opposite there is an electric theatre sign. It goes without saying that the gas and electric company keeps one spot well lighted. It has the most attractive window in the town.

The Alton Gas and Electric Company,

of Alton, Ill., has recently contracted for a bulletin service to help spread the light among prospective as well as actual customers.

The Danville Street Railway and Light Company, of Danville, Ill., is conducting a service of direct-by-mail advertising for business-getting.

The roof of a building in a commanding position (facing down a principal street, for instance) offers to the thoughtful and resourceful new-business manager an excellent opportunity to tackle some wide-awake advertiser on the subject of placing an electric sign, spelling the name of his product, at this point of vantage.

The DeKalb-Sycamore Electric Company, of DeKalb, Ill., is getting in line with the live procession. It has recently contracted for a quantity of very neat business-getters in the form of a monthly illustrated booklet to be mailed with monthly statements, etc.

There are few more aggressive electric companies than the Binghamton Light and Power Company. This illustration shows its get-down-near-the-people methods emphasized not only by a brilliant electric sign out over the pavement, but another on the inside of the office—Look closely at the halftone and you'll discover it.

The Toledo, Bowling Green & Southern Railway Company, of Findlay, Ohio, has recently moved into spacious and elegant new offices near the former location. The company intends to fit up a display room of electrical appliances second to none as soon as it gets other parts of the office settled.

The Consolidated Gas and Electric Light Company, of Tiffin, Ohio, is putting up a new night sign and otherwise adding to the attractions of its electrical display, thereby increasing the comfort and convenience of the public, as well as swelling the receipts of the cash drawer. The company says it pays to advertise and also that a good solicitor to follow up the advertisements is the next best thing.

Progressive Central Station Work at Bennington, Vt.

Bennington, Vt., is a town of only 5,600 people, with 9,000 incandescent lamps on its circuits. Nearly 2,000 of these incandescents, however, are the new "Gem" high-efficiency lamps with Holophane reflectors. The management, under J. E. Larrabee, president and general manager, has not waited for customers to discover the advantages of the metallized filament lamps, but has gone out of its way to push these modern illuminants, in the endeavor to give its customers more illumination for the same expenditure of energy. The result has been that the standard of illumination in the town has been raised, so that customers are better satisfied than formerly and at the same time are spending more money for electric current for lighting purposes. The company has endeavored not only to give the customers the new types of lamps and reflectors, but is placing the units according to the modern principles of illuminating engineering. This attitude on the part of the company is very effective in overcoming the agitation for municipal ownership, and is also enabling the company to compete successfully with gas for lighting, notwithstanding the fact that first cost of installation is, in many cases, somewhat higher.

A New Swedish Electrical Combination and Its Products.

A combination of three large electrical firms has been formed in Sweden. These firms are the Elektriska Aktiebolaget Magnet, Elektriska Aktiebolaget Halmia and the Clayton-Unger electrical machine works and foundry at Arbra. The oldest of these firms is the Halmia company, which was established in 1899. At that time it carried on the work of contractor and engineer, acting as agent for the Brown-Boveri company, of Baden. In 1903 it gave up its agency and took that for the Clayton-Unger machinery and apparatus. The Magnet company was formed in 1900 as manufacturer of electrical apparatus and electrical contractor. This company has not been successful, although it has a fine modern shop at Ludvika, four hours by rail from Stockholm. The manufacture of electrical machinery at Arbra and the mechanical engineering shops of the Unger company were begun by A. B. Clayton in 1903. Previous to this the shops had been devoted entirely to the construction of wood-working machinery. Since putting out electrical apparatus this has acquired a good deal of popularity, and within a few months it was found necessary to increase the shop to meet the incoming orders. A severe strike which took place in the fall of 1905 stopped all production, but the opportunity was seized for doubling and rebuilding the factory. The factory makes machines of all types, from small direct-current dynamos to large high-voltage alternators. It recently turned out a 350-kilowatt, single-phase rotary converter, one of the largest single-phase rotaries ever constructed. By the combination all the companies are amalgamated into a strong one. It employs 1,000 men and puts out about 130,000 horse-power in machinery yearly.—*Electrical Review (London) December* 21.

The Cooperative Electrical Development Association.

An important meeting of the Cooperative Electrical Development Association was held at the Hotel Imperial, New York city, on December 13, 1906. This meeting undertook a review of the work and the results accomplished by the association during the year just closing. Representatives of the larger manufacturing companies, several prominent central stations and various organizations connected with the electrical industry were present, W. M. McFarland, of the Westinghouse Electric and Manufacturing Company, acting as chairman. J. Robert Crouse presented the report for the Cooperative Electrical Development Association, and outlined a programme covering the work which might be undertaken for the next three years. A tentative constitution and by-laws was also presented.

The cooperative idea was conceived among the incandescent lamp manufacturers in February, 1905. Their plan, however, was a very restricted one compared with the present plans, inasmuch as they contemplated cooperative activities with the distributing trade which had for their objects solely the increased use of incandescent lamps. On May 12, 1905, the lamp manufacturers appropriated $10,000 to put the initial plans into effect. As the plans developed it was seen that a broader scheme for cooperating with the distributing trade was possible, and this scheme was elaborated in a paper presented before the National Electric Light Association at the Denver meeting in June, 1905. The National Electric Light Association was interested to the extent of appointing a committee of three central station managers to cooperate in the further development of the work. The subject in its broader aspects was presented again to the incandescent lamp manufacturers on February 7, 1906, when it was unanimously endorsed and an appropriation of one-fifth of one per cent on their entire sales covering a period of three years was made.

This broadened development led to a joint meeting of the manufacturers on March 23, 1906, and a cooperative committee including most of the manufacturers' representatives was formed. During the year an outline of the work and its developments was presented in the form of papers read before the various organizations connected with the electrical industry.

In outlining the work which had been done as a part of the scheme of cooperative effort during the year, Mr. Crouse stated that there appeared in the technical press 1,054 columns devoted to the subject of getting new business. If capitalized at current rates for advertising this would amount to $15,700. Concerning expenditures, these amounted to $28,256.41, with an additional expense of $9,280.21 incurred or contracted for.

Reports received from 934 central stations showed that ninety-six stations had organized new-business departments during the year, and that 165 had added solicitors to their staffs; that 193 had begun direct advertising; that 232 had begun newspaper advertising; that 195 had increased their advertising appropriations; that 165 had opened up display rooms, and that 181 had begun the operation of their own electric signs.

Concerning the plans for the future, on a basis of three years the activities scheduled would incur a total expenditure in 1909 of $100,750 for salaries and $267,800 for additional expenses.

The plans scheduled for 1907 are not quite as comprehensive as laid out for the three years, as considerable preliminary work would be done leading up to more extended effort. The schedule for 1907 would entail an expenditure of $49,250 for salaries and $111,300 for general expenses.

The report of the work accomplished and the plans for future activities were discussed very thoroughly by a number of the representatives present. The agreement was nearly unanimous to the effect that the work of the association had proved a remarkable stimulus in the sales of electrical apparatus; that it had awakened the central station managers to a realization of the possibilities of advanced methods of soliciting business, and that the able and conscientious work of Mr. Crouse should be fostered and given the entire support of the electrical industry. Several of the representatives of the larger central stations present endorsed the work of development and indicated their willingness to contribute their share financially toward the carrying out of this work. The opinion was very general that the scheme could be successful only when carried out along lines of great comprehensiveness. The only doubtful factor in the situation was the present overloaded condition of many of the manufacturers and the question as to the proper time to indulge in a greater effort to secure more business. In other words, it will be some time before many of the manufacturers can catch up with the orders already booked, and the question naturally arises whether it is good business to take away from the resources which are needed at the present time for the extension of facilities, to solicit business which they are unable to handle. On the one hand, the suggestion was made that the work be kept going and plans matured so that at a more propitious time a widespread educational campaign could be inaugurated. On the other hand, it was urged that there was no time like the present to inaugurate the educational campaign, so that if there should be a slump in business within the next two or three years the educational campaign would be in full blast and thus would temper the decline and induce a rehabilitation of business much sooner.

The discussion finally crystallized into the following resolution:

"*Resolved,* That it is the sense of this meeting that the commercial programme outlined for the Cooperative Electrical Development Association for 1907 and the future is along sound lines and gives good promise of highly profitable returns to all concerned.

"It is the further sense of this meeting that immediate steps be taken to perfect the organization of the association and to prosecute its commercial plans vigorously, pursuant to which the chair is requested to appoint three committees of five members each, as follows: committee on constitution and by-laws, committee on membership and assessments, committee on commercial programme."

Mr. McFarland announced the following committees:

Constitution and by-laws—E. E. Jackson, of Noble, Jackson & Hubbard; A. D. Page, of the General Electric Company; Walter Cary, of the Sawyer-Man Electric Company; F. J. Newbury, of the John A. Roebling's Sons Company; W. W. Freeman, of the Brooklyn Edison Company.

Membership and assessments—J. S. Anthony, of the General Electric Company; Walter Cary, of the Sawyer-Man Electric Company; W. W. Freeman, of the Brooklyn Edison Company; Charles B. Price, of the Pettingell-Andrews Company; James R. Strong, of the National Electrical Contractors' Association.

Commercial programme—F. S. Terry, of the National Electric Lamp Company; W. C. Bryant, of the Bryant Electric Company; R. S. Hale, of the Boston Edison Company; A. L. Doremus, of the Crocker-Wheeler Company; E. W. Gillmer, of the Warren Electric and Specialty Company; F. Bissell, of the F. Bissell Company.

The discussion continued during the afternoon, when it was determined to adjourn until such time as the committees just appointed were prepared to submit their reports.

The Chicago Electrical Show.

Formal Opening of the Electrical Trades Exposition, January 14, at the Coliseum, Chicago, Ill.

LAST year, before the first week of the Electrical Show at Chicago was ended, so satisfied were many of the exhibitors with the beneficial results apparent through bringing their products to the attention of those interested in electrical devices, that contracts were signed for space for the show which opens in the Coliseum on Monday evening, January 14. In addition to the many prominent firms which exhibited in 1906, a number of leading manufacturers have taken space for this year's exhibition. Early last year the directors of the Chicago Electrical Trades Exposition Company made a wise move in selecting Homer E. Niesz as managing director of the enterprise. Mr. Niesz has brought to the working out of the details of this exposition such an experience and understanding of the elements of management that apparently the electrical interests represented in the organization wait only for the opening night to witness a success even more gratifying than that of last year.

A liberal policy has been followed in the effort to make the exposition attractive both to those who come interested in the commercial possibilities of electrical developments, and the large aggregation of visitors who come mainly to be entertained. The Coliseum will be elaborately decorated, and a musical programme will be furnished throughout the day and evening.

The show will open on Monday evening, January 14, and will run from 10 A. M. until 11 P. M. every day but Sunday thereafter until January 26. Throughout the two weeks there will be several special days and a number of conventions and meetings. On Thursday, January 17, the anniversary of the birth of Franklin, souvenirs will be distributed. On January 16, 17 and 18 the convention of the Northwestern Electrical Association will be held. On Wednesday evening, January 16, the Sons of Jove will hold a rejuvenation and initiation of new candidates. Monday, January 21, has been designated as Telephone Day, and Wednesday January 23, has been designated as Thomas A. Edison Day. Upon each of these days souvenirs will be distributed. On Thursday, January 24, the annual meeting of the American Electrical Salesmen's Association will be held, and the Illuminating Engineers' Society, of Chicago, is scheduled to meet on Thursday evening, January 17.

A feature which will appeal to the sight-seer is the electrical midway, where W. J. Clarke will make many demonstrations of electrical phenomena. The electrical spectacle, "The Shipwreck," will be shown by the Aetna Electric Stage Lighting Company, of Chicago, and the "Aurora Borealis," the work of Edgar Healy, a scenic artist of Chicago, will also be shown. In addition to this an effort will be made to transmit, by means of the long-distance circuits of the American Telephone and Telegraph Company and the Chicago Telephone Company, electrical music furnished by the Cahill telharmonium from the central music station in New York city.

The Sons of Jove will exhibit an image of Lucifer, built on a solid background fourteen feet wide and fifteen feet high, and containing approximately 800 lamps ranging from four to fifty candle-power. By means of an ingenious arrangement of flashers constructed by Egbert Reynolds Dull, of the Reynolds-Dull Flasher Company, Chicago, Lucifer will appear from moment to moment translated into a dancing skeleton going through a series of weird contortions.

The accompanying diagram, together with the following schedule of exhibitors, will give a good idea of the extent of the exposition and the location of the individual exhibits. The data herewith presented have been furnished by the exposition management and the manufacturers, and are made as complete as was possible up to the time of going to press.

Armour Institute—D-23. Historical exhibit, plates and drawings by students, textbooks and laboratory paraphernalia.

American Steel and Wire Company—D-17 and 18.

American Telephone and Telegraph Company—D-19 and 20. Telephone booths, the "Theatrephone," and historical collection.

Aetna Electric Stage Lighting Company—D-8. Spot lamps, strip and border lamps and general theatrical appliances. Represented by E. T. Erickson, secretary.

Albert & J. M. Anderson Manufacturing Company—H-8. Time switch, switches and electric railway line material. Represented by Mr. Hincher, of the Chicago office.

Allis-Chalmers Company—C-5, 6, 7 and 8. Seventy-five-horse-power, self-contained, type AB alternating-current generator; ten-horse-power induction motor-generator set; fifteen-horse-power, high-speed engine generating unit; type "K" motors for direct current, from one and one-eighth to twenty horse-power, and six induction motors from one to twenty horse-power; models showing movable and stationary rings of blading of 500-kilowatt steam turbine; catalogues, bulletins and advertising matter; illustrations and photographs showing principal products. Represented by C. A. Tupper, S. R. Kerr, J. W. Gardner, C. H. Melvey, C. S. Buell, Ervin Dryer, F. L. Webster, J. M. Denniston, E. R. Jacobs, D. K. Chadbourne, H. I. Keen, J. C. Buckbee, A. W. Catlin, L. St. J. Smith, P. C. Van Zandt, George Voigt, and C. H. Howe.

American Clock Company—H-4. Time-recording devices; automatic self-winding electric wall and mantel clocks and synchronizing systems. Represented by H. O. Jackson, E. S. Eves, G. F. Randall and H. W. Pidgeon.

American Electrical Novelty and Manufacturing Company—C-18. Electric portable lights, novelties, clocks, dry batteries and automobile accessories. Represented by R. E. Bain, Chicago manager.

American Sewer Pipe Company—G-6. Single, two, three, four, six and nine-way ducts. Represented by W. R. Adams, sales manager conduit department, and J. M. McClave.

American Vibrator Company—C-3. Electrical vibrator. Represented by F. Seymour Temple, J. C. Massie and W. S. Heller.

The Antiseptic Company—A-7. Antiseptic telephone mouthpiece.

Automatic Electric Company—C-19 and 20. Complete installation of selector switches and automatic telephone connections, and combination showing interconnections between manual and automatic systems.

American Telephone Journal—D-6. Samples of the paper and text-books.

Bidwell Electric Company—D-8. The Bidwell cold motor, invented by Benson Bidwell; new refrigerating apparatus for hotels and markets; an automatic ice-cream freezer. Represented by Benson Bidwell and Charles F. Bidwell.

Bigley Telephone Company—I-2.

Brilliant Electric Company—F-7. "Brilliant," "Gem" and tantalum lamps, and, for the first time, the Brilliant tungsten and the new forty-four-watt lamp. This company will distribute an attractive souvenir. The Brilliant standard tipped and tipless lamps will also be shown. Represented by E. J. Kulas.

Bryan-Marsh Company—F-8. In connection with this company's exhibit will be that of the engineering department of the National Electric Lamp Association. Here will be found tungsten, tantalum, metallized filament and other recent improvements in the incandescent lamp industry. The engineering department has arranged a unique and interesting display which will be attractive both to the central station operator and the layman alike. A device will be installed to illustrate the effectiveness of the various lamps with regard to color values. Represented by E. H. Haughton, general manager; George Lockwood, manager of the New York office; F. M. Henkel, J. S. Corby, J. L. Barnard, F. W. Godfrey, M. L. Spaulding, Sam Furst, J. G. Peters, P. R. Slocomb, R. D. Cummings, W. R. Collins, L. E. Mason, R. M. Cole, E. N. Mullen and W. G. Reid.

Bryant Zinc Company—C-3.

W. J. Burns—I-7.

Chicago Lamp and Reflector Company—C-17. Art glass goods for illuminating purposes; electroliers and hanging domes. Represented by William Block and Harry Block.

Central Electric Company—D-9. Electrical specialties and novelties oof various descriptions; products of the D. & W. Fuse Company and the Columbia Incandescent Lamp Company.

Central Electric Manufacturing Company—C-15.

Chicago Compound Battery Company—D-7.

Chicago Battery Company—B-2 and 3.

Chicago Pneumatic Tool Company—F-5.

Chicago Telephone Company—D-11 and 12.

Chicago Edison Company—F-1, 2, 3 and 4.

Commercial Electric Company—F-9, 10, 11 and 12.

Frank B. Cook—E-3 and 4. Iron distributing frame equipped with various types of Cook protectors, pole cable terminals, guy clamps, clips and self-welding wire joints. Represented by John F. Tompkins, F. A. Rader, J. M. Moore, S. C. Harvey, E. M. Snow, F. R. Parker and F. W. Pardee.

Crane Company—C-4. Eight-inch, high-pressure, motor-driven ferro-steel gate valve, and twenty-four-inch hydraulically operated gate valve provided with electrical controlling device; valve auxiliaries. Represented by J. A. Minwegen and W. S. Rogers.

William P. Crockett Company—E-9. Electrical specialties, including "Diamond H" switches, Bossert boxes, Pittsburg standard conduit, Sterling flexible conduit, Dale specialties, DeVeau telephones, "Sarco" specialties, "Keystone" instruments and enclosed fuses. In attendance at this exhibit will be Charles Auth, secretary, DeVeau Telephone Manufacturing Company; T. C. Walsh, sales manager, DeVeau Telephone Manufacturing Company. J. F. Patterson, president, Dixon "tin can" will also be shown, giving the visitors an idea of how it looks to be canned. Represented by Fred R. Brandon and B. B. Worley.

Dossert & Company—C-2. Dossert joints and solderless connectors and terminals. Represented by H. B. Logan, J. J. Dossert, C. A. Flynn and E. A. Dossert.

Duncan Electric Manufacturing Company—E-19.

Edwards Electric Headlight Company—I-4.

Electric Appliance Company—E-8 and 16. Nine-foot sample board of "Sangamo" direct and alternating-current wattmeters; Packard "Gem" high-efficiency lamps, Packard transformers, "Eaco" telephones and "Paranite" rubber-covered wire reels. The Sangamo Electric Company, whose exhibit is at this booth, will be represented by A. D. Brinkerhoff and R. C. Lanphier.

Electric Rotary Floor Polisher Company—J-1.

Electric Service Supplies Company—F-13. Complete line of electric railway and mining supplies, Locke porcelain insulators, pro-

matic electrically driven house pumps and tankless water supply equipments. Represented by O. R. Erwin, Henry Erwin, A. C. Durdin, Jr., and Morris Weil.

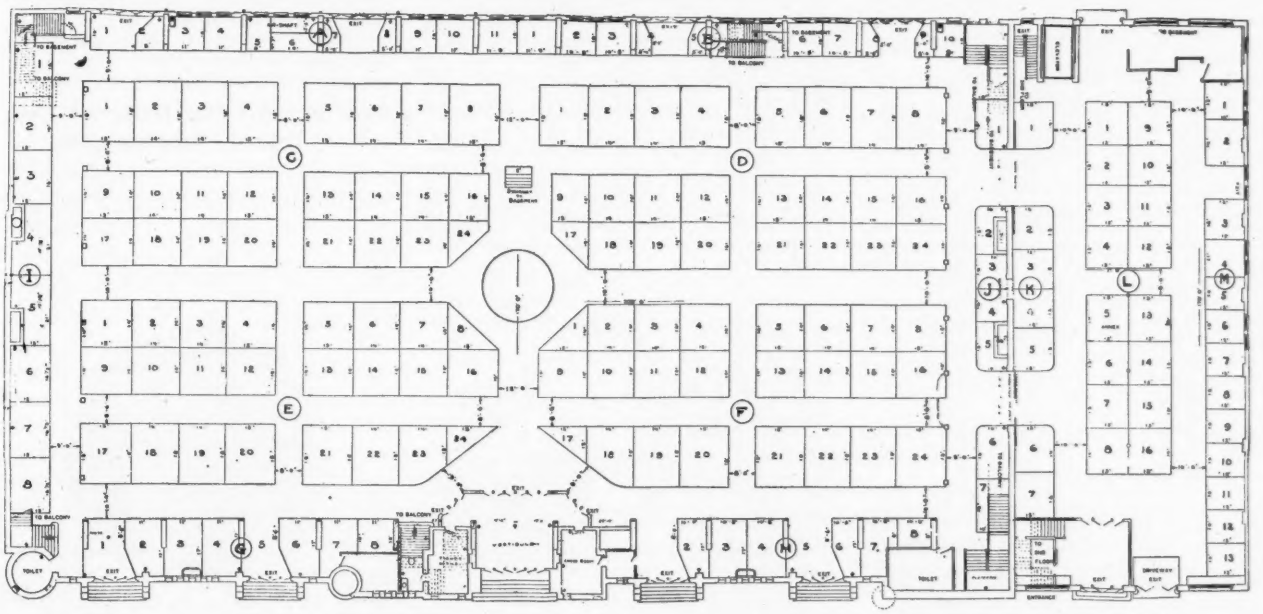
Eureka Electric Company—E-18. Sample line of telephones and switchboard apparatus. Represented by V. H. Messenger, G. H. Miller, F. H. Holroyd, V. H. Mehren and Mr. McCoy.

C. A. Everson & Company—D-5.

Federal Electric Company—E-7.

Fort Wayne Electric Works—C-13. Series alternating arc-lighting system, twenty-five-light capacity; standard switchboard; type SA regulator and type A transformer; types K and W single-phase, multiphase and prepayment wattmeters. In another part of the building a 150-kilowatt motor-generator set of this company's make furnishes energy for the exhibitors at the Electrical Show. This generating unit comprises a direct-current motor fed from the Chicago Edison Company's mains, and belted to a 150-kilowatt, multiphase alternator.

General Electric Company—F-19 and 20. "Gem" high-efficiency lamps, concentrating



PLAN OF EXHIBITION SPACES, MAIN FLOOR, COLISEUM, CHICAGO, ILL., ELECTRICAL TRADES EXPOSITION, JANUARY 14-26.

Enameled Metals Company. Harry Waterman, general sales manager, Sterling Electric Company. R. A. Schoenberg, president of the Sarco Company. Robert Jaynes, Hart Manufacturing Company. W. P. Crockett, A. C. Crockett, Maurice Levinson and S. H. Finney, William P. Crockett Company.

Dean Electric Company—C-9 and 10. Common battery multiple switchboard arranged for the latest Dean harmonic four-party selective ringing system, including individual indicating ringing keys on each cord circuit. All the latest Dean improvements in common battery apparatus will be shown in operation in this switchboard. The Dean harmonic converters will be shown in service, and there will also be exhibited common battery private exchange switchboards and magneto switchboards, wall and portable desk telephones. Represented by W. W. Dean, A. E. Parker, George A. Scoville, A. B. Smith, E. M. Ford and A. A. Hathaway.

Diehl Manufacturing Company—D-14. Small direct-connected generating set, exhaust wheels, desk and ceiling fans, special motors for driving job printing presses, buffing wheels, sewing-machines. Represented by Messrs. Carnahan and Gregory.

Joseph Dixon Crucible Company—A-4. Crucibles for melting brass, graphite brushes, lubricating graphite, graphite greases, resistance rods and electrical specialties. The

tected rail bonds, "Keystone" trolley material, Garton-Daniels lightning arresters, Hunter illuminated car signs, Wilson trolley catchers and retrievers, and arc headlights. Represented by J. W. Porter, M. A. Berg, E. R. Mason, J. M. Gallagher, W. P. Casper, H. L. Adams, P. E. Davenport, M. S. Earl and W. J. Dukes.

Electric Storage Battery Company—D-21 and 22. Various types of chloride accumulator and Exide batteries. A feature of this exhibit will be the "R-85" tank of the same size as the eight batteries now being installed by the New York Central & Hudson River Railroad Company. The company will also show cells for railway and lighting work, telephone work and for other classes of electrical work; car-lighting batteries and batteries for electric vehicles and ignition service, portable batteries for phonograph, medical and other applications. Represented by G. H. Atkin, J. M. S. Waring, H. B. Marshall, W. F. Rath, W. F. Bauer and F. W. Hyde.

ELECTRICAL REVIEW—F-23. Copies of the journal and posters. Represented by L. W. Marshall, A. A. Gray and P. S. Dodd.

Electrical World—F-24.

Electrocraft—B-10.

Engineering Publishing Company—J-6.

Engineering World—F-22.

Erwin & Company—F-17 and 18. Auto-

and diffused reflectors, high-candle-power lamps, standard lamps of every size and type, examples of motor-driven apparatus for domestic purposes, arc lamps, desk and ceiling fans, graphic recording wattmeters, electric cigar lighters, sewing-machine motors, and views of the company's works. Represented by a full corps of office managers and salesmen.

Gould Storage Battery Company—E-20. Car-lighting equipments, batteries for electric vehicle and ignition purposes, photographs of battery parts and exhibition of battery auxiliaries.

Emil H. Grubbe, M. D.—J-7.

Guarantee Electric Company—B-4. Variable-speed motors, commutators, armature coils and a practical demonstration of armature winding. Represented by Charles E. Gregory.

J. Allen Haines, Incorporated—C-16. Representing the following companies: American Electrical Heater Company, electrical heating apparatus, including the new steel-clad laundry irons represented by Robert Kuhn. Bishop Gutta Percha Company, sample board of insulated wires and cables which was displayed at the Centennial Exposition in Philadelphia in 1876. Clifton Manufacturing Company, friction tape, insulating tape, insulating compounds. Dayton Electrical Manufacturing Company, "Ap-

ple" ignition system; Represented by V. G. Apple. Electric Cable Company, "Voltax" insulated wires and cables. Schwarze Electric Company, "Universal" bells and gongs and railway signal apparatus. Stanley & Patterson, Incorporated, "Matchless" flashers, "Imperial" sunlight reflectors, "Newcode" receptacles and sockets, "Fielding" stage receptacles, Hubbell floor boxes. The Wire and Telephone Company of America, sample board of "Romeoid" wires, magnet wire, telephone wire, "Easophone" equipments. Represented by Oliver Shiras and H. A. Hammond. The Haines Company will be represented by J. Allen Haines, Dwight G. Welling, Otis D. Allen, A. Conro Fiero, George A. Collins and Loyal F. Ross.

Haller Machine Company—J-2, 3, 4 and 5.

Felix Hamburger—H-6. Siemens direct-current and alternating-current flaming arc lamps; "Jupiter" direct and alternating-current flaming arc lamps made in the United States; Siemens "Liliput" direct-current and alternating-current two and three-ampere arc lamps; Siemens "Economy" direct-current five-ampere arc lamps; "Radiante" lamps made by the Carbone Company, of Berlin, Germany; various types of flaming arc lamps, and the "Sirene," a new electrical acoustic apparatus. Represented by Max Austrich.

Health Vibrator Company—C-2.

Hepburn Telephone Company—A-8.

Holtzer-Cabot Electric Company—C-1. Watchmen's clocks, interior intercommunicating telephones, weatherproof telephones, police telephones, standard and weatherproof loud-ringing gongs, vibrating bells and standard telephones, annunciators, single-phase motors, direct-current motors, storage battery charging motor-generator sets, signaling devices, watchmakers' lathe motors and dental lathe motors, portable telephones for interurban railways, and the "Flexiphone" adjustable telephone bracket. Represented by E. R. Harding, A. E. Klunder and T. G. Meinema.

H. W. Johns-Manville Company—E-15.

International Correspondence Schools—H-7.

Kellogg Switchboard and Supply Company—E-17.

J. Lang Electric Company—A-6.

W. N. Matthews & Brother—A-3. "Stombaugh guy anchor, "Kearney" cable clamp, "Hold-Fast" lamp guard, "Lima" jack box and plug, "Hargis" splicing joint, "Callahan" rollers, "O. K." slate cutters. Represented by W. N. Matthews and Claude L. Matthews.

McRoy Clay Works—F-22.

Metropolitan Electrical Supply Company—C-2.

Monarch Electric and Wire Company—C-23 and 24. Representing H. W. Johns-Manville Company, exhibiting "Noark" fuses; Long-Distance Telephone Manufacturing Company, telephones and telephone parts; Hemingray Glass Company, glass insulators and globes; H. T. Paiste Company, sockets, switches, condulets; Nurnberg flaming arc lamps. Represented by L. A. Schwab, A. D. Gillespie, E. W. Kearns, H. E. Mason and E. J. Cassin.

National Battery Company—F-14. Unit accumulator shown in small couples or two-plate cells suitable for low discharges, adapted for telephone exchanges and private exchanges; fire and police alarm telegraph systems; samples showing the construction of the positive and negative plates.

National Carbon Company—E-6.

Nungesser Electric Battery Company—A-5. Dry batteries. Represented by Thomas G. Grier, H. S. Greene and P. J. Cratty.

Ohio Brass Company—D-7. Trolley ears, trolley hangers and one-piece rail bonds.

Oliver Manufacturing Company—E-1. "Flexiphone" telephone bracket and "Flexilite" lamp adjuster.

Oneida Community, Limited—F-16. Oneida galvanized chain for the suspension of arc and incandescent lamps.

Peabody Coal Company—I-5.

Peirce Specialty Company—E-2. Steel construction material, vitrified clay conduit. Represented by C. L. Peirce, Jr., R. L. Crane, H. M. Legnard and A. L. Haase.

H. A. Petersen Manufacturing Company—D-5. "Harveyduct" electrical conduits and fittings.

Phoenix Glass Company—A-9. Electric lighting glassware, consisting of etched, cut, decorated and other effects, Phoenix inner globes. Represented by E. H. Fox and C. C. Fricke.

Public Service Company—F-23.

Reynolds-Dull Flasher Company—J-2, 3, 4 and 5. It is stated that this exhibit will show the greatest variety of flashing devices for electrical advertising that has ever been shown in a single exhibit. It will include practically everything known in the art, from the smallest flasher which winds with a key to a flasher of thousands of watts capacity. Represented by E. R. Dull and John Friis.

Roth Brothers & Company—D-24.

J. L. Schureman Company—B-1. Automatic pump starter, elevator controllers and magnet switches. Represented by J. L. Schureman and Frederick Nelson.

W. H. Schott—C-22. The feature of this exhibit will be the purple and white decorations and the beautiful advertising sign. The idea carried out in this exhibit is to provide an elaborate reception room for visitors. Represented by M. O. Payne, D. T. Wallace, C. A. Gillham and F. B. Hofft.

Shelton Electric Company—C-14. The Shelton vibrator.

The Simplex Electric Heating Company—F-21 and 22. Complete line of electric heating and cooking appliances. Electric cooking will be demonstrated. Represented by H. R. Hixson, F. S. Richards, E. A. Strauss, J. N. Macallister, J. G. Brobeck and W. F. Hruby.

Stolz Electrophone Company—F-15. A pocket telephone for the use of the deaf.

Stromberg-Carlson Telephone Manufacturing Company—E-5 and 13.

Swedish-American Telephone Company—E-11 and 12.

Telephony Publishing Company—D-6.

Thomas & Smith—B-7.

Thompson & Read—B-8.

Universal Manufacturing Company—G-7.

Universal Electric Storage Battery Company—D-13. Private house lighting plant complete, including Fairbanks-Morse gasolene engine belted to a Crocker-Wheeler three-kilowatt generator. Represented by A. F. Callahan, Walton Bentley and J. S. Burnet.

Vesta Accumulator Company—A-10.

Vim Company—E-19.

Vought-Berger Company—E-10.

Vulcan Electric Heating Company—E-14. Electric heating specialties, branding and soldering irons. Represented by L. P. Brown, G. M. Cox, J. W. Fay and F. J. Holmes.

Wagner Electric Manufacturing Company—D-10. Single-phase elevator motor complete with controller; transformer showing features of construction; switchboard and portable measuring instruments; single-phase vertical motors for pumping purposes. Represented by F. N. Jewett, C. C. Warner, C. B. Richardson, T. M. Combiths and V. W. Bergenthal.

Western Electrician—F-24.

Western Electric Company—E-21, 22, 23 and 24. A large water color painting of the 110-acre plant at Hawthorne, Ill.; "American" transformers; "Thomas" high-tension insulators; "Electrose" insulating material; Western Electric arc lamps; field coils; induction motors; sewing-machine motors and other electrical apparatus. Represented by H. A. Halligan, C. A. S. Howlett, I. Hulett, John Dietrick, H. E. Griffin, H. J. Elliott, I. Young, Irving Parker, William Self, F. T. Murphy, F. R. Babcock, H. A. Hoagland, O. B. Duncan, W. H. Woods, B. S. York, L. J. Baldwin, O. O. Tucker, C. Garner, H. D. Haring, H. W. Dye, M. R. Lash, R. M. Baker, D. C. Guest, W. W. Templin, P. Joyslin, F. H. Hulscher, A. R. McNally, R. C. Kearslay, G. H. Lounsbery, F. A. Henderson, F. H. Boardman, W. L. Stockton and H. Walton Heegstra.

Westinghouse Companies—D-1, 2, 3 and 4. Voltmeters, ammeters, lightning arresters, fan motors, small alternating-current and direct-current motors, railway line material, pipe-thawing transformers, circuit-breakers and industrial motors. Demonstrating the adaptation of motors to industrial purposes will be a motor-driven dough-mixer, centrifugal pump, mangle, sewing machine, laundry washer, ventilating blower, ticketing machine, plunger pump, ice-cream freezer, forge, dust-remover, graphophone, ice-making machine, sixteen-inch engine lathe, coffee grinder and dish-washer. The exhibit will be lighted by means of direct-current multiple arc lamps, alternating-current series arc lamps and alternating-current multiple arc lamps. Street series Nernst lamps will be shown burning in conjunction with series arc lamps connected to a series light Westinghouse regulator. Both type H and type K Cooper-Hewitt mercury-vapor lamps will be shown in operation. Among the representatives in attendance will be the following: Westinghouse Electric and Manufacturing Company—T. P. Gaylord, E. M. Bischoff, A. L. Millard, T. P. Pinckard, S. L. Nicholson and Charles Robbins. Nernst Lamp Company: Max Harris, C. H. Davis and Frank McMasters. Cooper-Hewitt Lamp Company: George C. Keech.

American Institute of Electrical Engineers.

The 213th meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth street, New York city, on Friday, January 25, 1907, at 8.15 P. M. The following paper will be presented by Lewis B. Stillwell and Henry St. Clair Putnam: "Substitution of the Electric Motor for the Steam Locomotive." The paper will include:

1. Presentation of certain facts established by experience in the operation of elevated, subway and interurban lines by electricity.

2. Discussion of comparative cost of operation by steam and electricity applied to railways in operation, and including both passenger and freight service.

3. The importance of standardizing electric railway practice.

4. The question of frequency in the operation of railways by alternating current.

Members of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the New York Railroad Club and the Transportation Club are cordially invited to attend this meeting.

Frederick P. Fish Lectures Before the American Society of Mechanical Engineers.

On the evening of Tuesday, January 8, Frederick P. Fish, president of the American Telephone and Telegraph Company, lectured before the American Society of Mechanical Engineers at the Engineers' Building, New York city, on "The Ethics of Trade Secrets in Relation to the Patent System."

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Multiple-Scale Switch.

Since the invention of multiple-scale voltmeters there has been need for a simple device to protect them against injury resulting from a wrong connection. It is always easy to connect by mistake a high-potential to the low-reading side of a voltmeter, the result being a damaged pointer and frequently a burned-out coil. The American Instrument Company, Newark, N. J., has placed on the market a multiple-scale switch which is provided with all of its portable voltmeters which have more than one range, making it practically impossible to injure the instrument by careless connecting or through ignorance. This multiple-scale switch is shown in the accompanying illustration. It is placed on the instrument where it is easy to see and to operate.

Normally the indicator stands at open, as is shown in the illustration herewith.

MULTIPLE-SCALE SWITCH.

Connection is made to the one pair of binding posts, no matter what range is wanted; then a button is turned until the indicator points to the range desired, and the readings are made. The switch is securely held in position for the required range until the operator is through; then, either by pushing a button or closing the lid of the instrument it is released and flies back to the open position. Thus the switch always stands at open when the instrument is not in use, and it is impossible to use the low range without connections having first been automatically made to the higher ranges; consequently, the operator is forced to think and see exactly what he is doing.

This device has been designed with great care and thoroughness, and is placed on the market to meet actual conditions which have been exhaustively studied. The general sales agent of the company is James G. Biddle, 1114 Chestnut street, Philadelphia, Pa.

A New Line of Wireless Clusters.

The Benjamin Electric Manufacturing Company, Chicago, Ill., has placed on the market a new line of wireless clusters for two-light devices, all of these devices being arranged to burn two lamps in series. The No. 412½ twin-socket device, shown in Fig. 1, has hitherto been furnished connected only for multiple work. The company is now prepared to furnish these to burn two lamps in series. The recent improvements in incandescent lamps, in which metal filaments are being used, have established more or less as a standard voltages of 120 and 125. However, in many instances the wiring installation includes circuits of 220 volts; consequently, there is an increasing demand for devices in which two lamps can be burned in series.

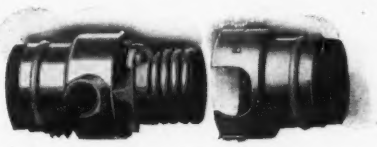


FIG. 1.—TWIN SOCKET.

The twin-socket device is largely used in window lighting, so that the lamps can be placed parallel to the surface to which the socket is attached. The device is also used for fixture work, where the lamps may be placed either in a horizontal position with half shades over them, or in a vertical position.

The No. 22½ cluster, shown in Fig. 2, serves the purpose of a two-light device for ordinary cluster purposes. The No. 19½ bracket, shown in Fig. 3, enables the lighting of side walls in groups of two lamps in series. The No. 92½ receptacle plug is used for circuits wired in multiple where 220 volts obtain, but where it is desired to use 110-volt lamps. For clusters of four or six lights the type 1 cluster, shown in Fig. 5, connected as demonstrated in the three diagrams, Figs. 6, 7 and 8, serves the purpose very nicely, enabling four lamps to be burned on two different circuits, two lamps in series on each; or on one circuit, two in series; or, again, with six lights in series-parallel arrangement, each circuit having two lights in series.

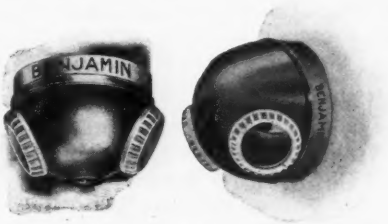


FIG. 2.—CLUSTER. FIG. 3.—WALL BRACKET.

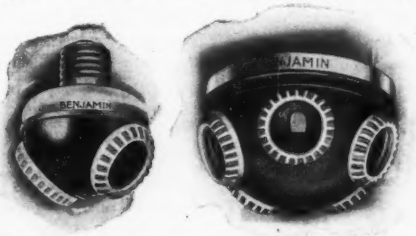


FIG. 4.—RECEPTACLE. FIG. 5.—TYPE 1 CLUSTER.

Babcock & Wilcox Company Purchases Interests of the Stirling Consolidated Boiler Company.

The Babcock & Wilcox Company has bought from the Stirling Consolidated Boiler Company, as of December 31, 1906, its American property and interests, including all accounts and bills receivable, and has assumed its obligations and will execute its orders and contracts for boilers and appurtenances for installation and use in the United States.

The plants thus purchased will be operated in the future by the Babcock & Wilcox Company under the name and style of "The Babcock & Wilcox Company, (Stirling Department)," and will be

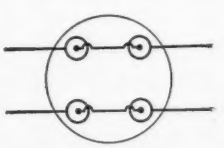


FIG. 6.—FOUR LIGHTS, TWO CIRCUITS, 2 AND 2.

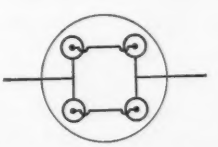


FIG. 7.—FOUR LIGHTS, SERIES-PARALLEL. ONE CIRCUIT, 2 AND 2.

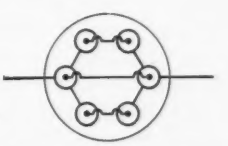


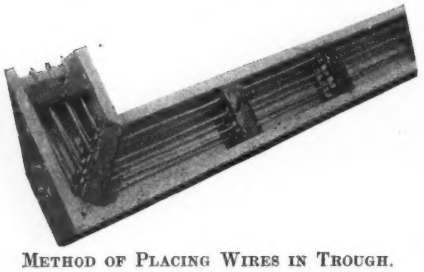
FIG. 8.—SIX LIGHTS, SERIES-PARALLEL. ONE CIRCUIT, 2, AND 2 AND 2.

operated under the direct charge and management of the same gentlemen who have operated the Stirling Consolidated Boiler Company. The gentlemen who have been connected with The Stirling Consolidated Boiler Company in its sales department will be associated with The Babcock & Wilcox Company in similar capacities.

The Babcock & Wilcox Company (Stirling Department) will manufacture the Stirling, Aultman & Taylor and Cahall water tube boilers and appurtenances heretofore manufactured by the Stirling Consolidated Boiler Company.

The Hungerford Insulating Compound and Rubber Substitute.

The Dielectric Company of America, of Belleville, N. J., has purchased the old plant of the Hungerford Electric and Manufacturing Company, at Essex, N. J., and is now manufacturing the insulating



Method of Placing Wires in Trough.

compounds and insulating wire under the system invented by Oliver T. Hungerford. As a substitute for tile or metal conduits this compound is used by placing in wooden troughs the current-carrying wires, which are held in proper relation to the trough by means of spacers placed at such distances as will best suit the requirements of the particular installation. The insulating compound is then poured into the trough, hermetically sealing the conductors into a solid insulating block. It is stated by the company that this compound has been brought to such a state of perfection that its depreciation is negligible, and it is unaffected by extreme changes in temperature or exposure to corrosive elements. This compound has recently been used by the Port Jervis Electric Light, Power, Gas and Railroad Company, Port Jervis, N. Y., for the underground system under Main street and Pennsylvania avenue. This underground work is necessary because of an ordinance forbidding the carrying of 10,000 volts across the public streets. The 10,000-volt line is carried on poles to the edge of the street, at which point the wires are carried down the sides of the poles in two two-inch pipes to the box under ground. The wires run through this box under the streets to the pole located on the other side of the streets in question, and then pass through two-inch pipes up the side of the pole to the overhead line. Three wires are carried in each of these pipes, the potential between any pair of wires being 10,000 volts. The circuit consists of two three-phase conductors. The wire used in this pipe construction is ordinary rubber-covered wire, and each wire is pulled through ordinary one-half-inch flexible conduit. This is boiled in "Dielectric" compound, allowed to dry, and then pulled through the pipes. The pipes are then filled with the compound. It is stated that the cost of this installation was very materially reduced by the use of this system of insulation.

This system has also been used by the Erie Railroad and has given a great deal of satisfaction.

The Bergen division of the Public Service Corporation of New Jersey made use of the system recently for putting its wires under ground from its transformer station to the Hackensack river. This work was made necessary through the abandonment of an old cable house and the removal of the apparatus to a new brick cable house some distance further from the river. The moving necessitated either replacing several of the submarine cables or splicing the old ones in order to reach the new cable house. The latter method was decided on, and was executed by placing twenty-four wires in a wooden trough and filling in with the compound.

This box carried six 2,200-volt circuits, twelve 5,500-volt circuits, four 6,600-volt circuits and two 110-volt secondary wires. The system proved entirely satisfactory.

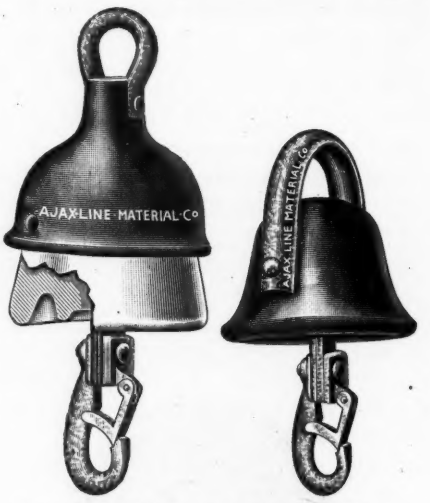
The Dielectric Company of America now has facilities for making from 5,000 to 7,000 pounds per day of the insulating compound.

As a substitute for rubber-covered wire the company is placing on the market an insulated wire made under the Hungerford patents, which, it is stated, is in every way applicable for all services for which weatherproof wire may be adopted, at the same time being cheaper in construction than rubber-covered wire. Under a test recently made, three samples of this rubber-covered wire withstood a puncture test after soaking twenty-four hours of 10,400, 15,200 and 9,240 volts, respectively. A second set of samples withstood puncture tests of 15,560, 17,680 and 17,000 volts, respectively. The company has facilities for producing about ten miles of insulated wire per day. It is expected that in about three months this capacity will be doubled.

Every machine in the company's factory is direct-driven by specially designed motors, current for these motors and for the lighting of the factory being furnished by an equipment of American-Ball engines and Crocker-Wheeler generators.

Four Ajax Insulators.

The Ajax Line Material Company, Chicago, Ill., has placed on the market four new insulators, which are shown in the accompanying illustrations. These



Ajax Line Insulators with Snap Hook.

insulators have been designed to meet the demand for stronger construction and higher insulating qualities for arc circuits. Each of the insulators shown herewith has an ingenious interlocking of the

Ajax Insulated Turn-Buckle.

parts, which will hold them together even if the insulation is shattered, and each is equipped with an easily manipulated Ajax snap hook. One form of insulator is made up with hard-rubber insulation, while an-

Ajax Insulated Bolt.

other form, for higher voltages, is made up with vitrified porcelain. The distinctive features of these insulators are due to Albert Scheible, under whose pending patents they are made, and who has also begun the use of channel steel for extra strength in making the Ajax insulated bolts and turn-buckles shown herewith.

Current Electrical News

DOMESTIC AND EXPORT.

MERGER OF TELEPHONE COMPANIES—The Pacific States Telephone and Telegraph Company and the Sunset Telephone and Telegraph Company, with systems reaching every part of the Pacific slope, will be merged into a new company to be called the Pacific Telephone and Telegraph Company. The new company will be capitalized at $50,000,000.

TO ISSUE LARGE MORTGAGE—The New York state railroad commission has consented to the issue of a first and refunding mortgage of $12,000,000 by the Buffalo & Lake Erie Traction Company, to secure the issue of a like amount of thirty-year five per cent gold bonds. This corporation was formed in New York and Pennsylvania by consolidation and merger of the Hamburg Railway Company, Dunkirk & Fredonia Railroad Company, Buffalo, Dunkirk & Western Railroad, Lake Erie Traction Company and the Erie Rapid Transit Company.

NEW CANADIAN POWER COMPANY—The Canadian Light and Power Company has been organized with a capital of $4,000,000, and has applied to the Montreal (Canada) city council for permission to operate in that city. It is understood that the company has leased the Beauharnois canal from the Dominion government and will develop its power from that source. Among those interested in the Canadian Light and Power Company are the following: F. Howard Wilson, William Cassils McIntyre, William. C. Finley, E. A. Robert, George G. Foster, K. C.; S. H. Ewing, H. J. Fuller, P. J. McIntosh, F. J. Shaw and William Lyall.

AGAINST NEW RAILWAY PLAN—The application of the Philadelphia Elevated and Subway Railway Company to build an elevated and subway line from Sixty-third and Ludlow streets to the Delaware river, a distance of six miles, has been refused by the state board of elevated and underground railways. The reasons given for the rejection were that "the proposed railway company would, if a charter were granted, occupy several of the most important streets of the city of Philadelphia," and that sufficient evidence was not produced before the board to show the necessity for the railway. The company is capitalized at $300,000, and its charter application has been pending nine months.

BROOKLYN EDISON COMPANY WINS IN SUIT AGAINST CITY—In three actions growing out of the suit of the Edison Electric Illuminating Company, of the borough of Brooklyn, New York city, to compel the city to pay claims alleged to be due for furnishing heat, light and power, Justice Burr, of the Supreme Court, Brooklyn, decided that the city shall pay the third claim of $616,125.21. As to the other claims the court directed that the company establish a fair and reasonable value of the commodity furnished to the city. The city had refused to pay the claims of the company on the ground that the charges were greater than those asked from private consumers. The city demanded that the bills be reduced. This the company refused to do, saying it had contracts with the city for stated prices.

MERGER OF RAILWAY COMPANIES—The board of railroad commissioners of New York state has granted the application of the United Traction Company, of Albany, N. Y., for permission to increase its capital stock from $5,000,000 to $13,500,000. The new issue will be used to take up the outstanding securities of the Hudson Valley Railway, which are owned by the United Traction Company. Steps toward the consolidation of the two companies were taken at a meeting of the United Company several weeks ago. The Hudson Valley company was formed in 1901, and operates in the territory from Troy to Saratoga and north to Caldwell and Warrensburg, on Lake George. The capital stock is $3,000,000, and the original bond issue amounted to $4,000,000. There has since been a debenture issue to meet the requirements of the company.

MEXICAN ELECTRICAL NOTES—B. J. Mahoney, who is behind a plan to establish at La Joya, on the Conchos river, a large hydroelectric plant, announces that the Conchos River Power Company has been organized with a capital of $1,500,000, under the laws of New Jersey, to carry out the enterprise. The concession was originally obtained by R. M. Burke, formerly United States consul at Chihuahua, and now vice-president of the company. The Lerdo & Torreon Electric Tramways Company has purchased the Torreon local tramways and will increase its capital stock to $100,000. Under a concession from the government bearing date December 12, S. Pearson & Son, Limited, represented by John B. Body, is authorized to erect the works necessary to utilize for motive power 340,000 litres of water per second from the Antigua river in the Canton of Jalapa, state of Vera Cruz. The works may be placed on the line of the river anywhere between a point twenty kilometres above the Puente National and another point ten kilometres below the bridge. The concessionaire agrees to commence surveys within six months and construction within twenty-four months, and to complete the work within seven years.

CHICAGO TRACTION PLAN—It is stated that the details of the proposed new traction have been agreed upon by representatives of the city of Chicago and the controlling interests in the Chicago City Railway Company and the Chicago Union Traction Company. After the adoption of the new ordinance, which is expected to be accomplished shortly, a reorganization plan will be submitted to the holders of the various securities of the Chicago Union Traction Company, but the details of this plan have not yet been perfected. The new ordinance provides, among other things, that the city shall receive fifty-five per cent and the company forty-five per cent of the net earnings, the properties to be operated by the present controlling interests. The city will have the right to buy the properties of the Chicago Union Traction Company for $29,000,000 and those of the Chicago Railway Company for $21,000,000, a total of $50,000,000. The companies will, under the ordinance, be reimbursed for whatever expenditures are made for improvements from a recent date to that of purchase by the city. The capitalization of the new company will include ample funds to rehabilitate the properties, the expenditure perhaps amounting to as much as $40,000,000.

PROPOSED CABLE LINE TO PORTO RICO—Through its president, James A. Scrymser, the Central & American Telegraph Company has made application to the War Department for permission to land a cable at San Juan, Porto Rico, and also at Colon, on the Isthmus. According to the representations made by Mr. Scrymser to Secretary Taft, it is the desire to lay a cable from New York to Porto Rico and then connect from Colon with a telegraph line across the isthmus to Panama to meet its cable on the Pacific side. The secretary has taken the proposition under consideration. It is the desire of the War Department to have an all-American line of cable connecting Cuba, Porto Rico and the Isthmus with the mainland of the United States. In case of war such a line, it is held, would be of vast importance, as it could be seized and held under control by this government. The advantage in times of peace would be in the competition with the French cable now in existence, and consequently a lower rate. At the last session of Congress a bill was introduced and passed the Senate providing for a military cable covering practically the same territory, but with a connection at the naval station at Guantanamo, Cuba. This bill, however, which involved the expenditure of about $2,000,000, was lost in the House. Secretary Taft in considering the application of Mr. Scrymser will give due weight to the chances of the present Congress passing the bill for the military cable. It is believed that if he is convinced there is little hope for the bill he will accept the proposition made and allow the company to go ahead with the laying of the cable, probably requiring that it shall make a connection with Guantanamo.

ELECTRIC RAILWAYS.

COLTON, CAL.—The franchise for a double-track electric road from Colton to Riverside has been sold to A. C. Denman.

WALLACE, IDA.—William J. Hall has been granted a franchise to build an electric railway through the streets of the city.

BUTTE, MONT.—James Breen, of Spokane, and his associates purpose building a line from Butte to Anaconda *via* Gregson Springs.

SPOKANE, WASH.—The Spokane Traction Company has placed an order for ten cars of the Detroit type for delivery in March. The company has been extending and double-tracking several of its lines, making more cars necessary.

SPOKANE, WASH.—The stockholders of the Spokane Valley Railroad Company have confirmed plans for the sale of the company's property to the Spokane Western Power and Traction Company. The selling company will be dissolved.

LAWTON, OKLA.—William Pettigrew, a ranchman of the Chickasaw nation, has proposed the building of an electric interurban line between Duncan and Marlow. Citizens of both towns are considering the matter of organizing a stock company to push the enterprise.

SPOKANE, WASH.—A company headed by A. M. Dewey, of Spokane, has been incorporated in Washington with a capital of $3,000,000 to build an electric railway from Nighthawk to Loomis, seventy miles, and eventually through the following towns: Conconully, North Alma, Malott, Ophir and Brewster, 150 miles.

MAQUOKETA, IOWA—At a mass meeting held in the city hall, on the call of the Maquoketa Commercial Association, the final dollar of Maquoketa's $10,000 subscription toward the building of an electric interurban between Davenport and Dubuque was raised, and work on the preliminary survey has been commenced.

FOREST GROVE, ORE.—An electric line from Portland to Forest Grove is contemplated by the Oregon Electric Company, the successor of the Willamette Valley Traction Company. The line would connect with the Salem road of the company near Bertha, would be twenty-two miles long and would cost $1,000,000.

SPOKANE, WASH.—Construction of an interurban electric railway from Bellingham to towns and valleys of Skagit county by Stone & Webster, is confirmed by L. H. Bean, manager of the Whatcom County Railway and Light Company. The company will build ten miles of line in Whatcom county and thirty-three miles in Skagit county. The entire cost of the system will be $2,000,000.

NASHVILLE, TENN.—Financial arrangements for the construction and equipment of the Nashville & Lewisburg Interurban Electric Railroad will be concluded within the next sixty days, and the company expects to have trains running on schedule time within the next twelve months. This announcement is authoritatively made, and it is further coupled with the statement that the work of actual construction is to be begun at once.

ALBANY, N. Y.—The Steuben Traction Company, of Hornell, a consolidation of the Hornellsville Electric Railway Company, Hornellsville & Canisteo Railway Company, Canisteo Valley Railway Company and the Canisteo, Jasper & Wood Hill Railway Company has been incorporated with a capital of $370,000. The company will operate an electric road. The directors are: Charles Adsit, of Hornell; J. W. Powell, of Canisteo, and L. D. Whiting, of Jasper.

SOUTH HAVEN, MICH.—S. J. Dunkley, who has been working on the interurban railway project, says the necessary money has been raised to complete the road to South Haven, and also to construct branches to Paw Paw Lake and Saugatuck. Right of way is being acquired as rapidly as possible, and the company expects to have the road completed and cars running to South Haven by March next. The capital subscribed to complete the road was $4,000,000.

ATLANTIC, IOWA—The Atlantic Northern & Southern Railroad has been organized by a company of Atlantic business men with a capital of $150,000. The company expects to build an interurban road from Manning to Villisca *via* Elkhorn, Atlantic, Cumberland and Carbon. J. H. Simmons is president and J. Stier, secretary. Over 600 Atlantic citizens are pledged to give it support. Preliminary work is to commence at once. The first line is to be built north from Atlantic.

SHELBURNE FALLS, MASS.—Martin Brown, representing the Deerfield River company, of Wilmington, Vt., a large lumber company, and others, has secured a controlling interest in the stock of the Shelburne Falls & Colrain Street Railway. For the options and the stock purchased $25 a share is paid, the par value being $100. The Vermont legislature has granted a charter for the construction of a road connecting Wilmington and Whitingham and extending to the Massachusetts state line in Halifax and Colrain.

SMITH'S FERRY, PA.—J. F. Reed, of Beaver, Pa., in asking for a Pennsylvania charter for the Woodlawn Electric Street Railway Company, has taken another step in continuing the links of electric railways to form an outlet from Pittsburg to the lower Ohio valley. This new road will extend from the Pittsburg & Lake Erie station at Beaver to New Sheffield. The road will be about six miles in length, and the general offices of the company will be located at Aliquippa. The incorporators of the new company are D. G. Dugan, S. J. Dugan, James A. Newell, J. E. Wilson and R. Burgher.

DECATUR, ILL.—J. J. Finn, of Decatur, president of the Springfield & Pana Interurban, says the road will be built during the coming year. It will be fifty miles in length and will cost $33,000 per mile. The New Orleans Construction Company has the contract and G. R. Turner and B. V. B. Dixon are among the capitalists interested in the enterprise. The principal financial backing comes from New Orleans, although there are St. Louis and Central Illinois capitalists interested. The line parallels the Baltimore & Ohio and in addition to passenger business is expected to be a coal-carrying line.

SPOKANE, WASH.—Jay P. Graves, president of the Spokane & Inland Empire Company, has made application to the city council for a franchise to construct a two-track tunnel, one mile long, in Front avenue to connect the freight and passenger terminals, at a cost of $1,000,000. The subway will be thirty-eight feet wide, twenty-two feet deep, the crown being at least four feet from the street surface. Two years will be required to build it. Mr. Graves announces that by the use of the subway the time of trains between Spokane and Coeur d'Alene, Ida., thirty-four miles, can be cut to fifty minutes.

NORFOLK, VA.—A hundred thousand dollars will be expended by the Norfolk & Portsmouth Traction Company in straightening the curves and otherwise bettering the Norfolk & Atlantic Terminal line from Norfolk to the Jamestown Exposition grounds. This work, which will be commenced immediately, is for the purpose of enabling the company to run trains from Norfolk to the exposition in twenty-five minutes with safety. One of the boilers in the traction company's $900,000 power plant, now under construction on the water-front in Brambleton, will be ready for use next month, and will augment the power needed by the company in the operation of its cars.

NIAGARA FALLS, ONTARIO—A despatch from Windsor announces that a large electric railway project is connected with the application of the Twentieth Century Transportation Company for a charter to run a ferry across the Detroit river between Windsor and Detroit. The scheme is to build an electric line across Southern Ontario from Detroit to Buffalo, touching Ridgetown, St. Thomas, Welland and many other places. At the Detroit end the line would connect with a system of electric lines radiating from that city to many points in Michigan. Cars and passengers would be transferred from the Detroit terminal of these lines across the Detroit river and then east by the line which it proposed to build.

SAN FRANCISCO, CAL.—Amended articles of incorporation for the Santa Clara Interurban Railroad Company, of which L. E. Hanchett is president and S. S. Baldwin secretary, have been filed, the new articles having been adopted at a meeting of the directors on December 5. The new electric road will be built from San Mateo to Alum Rock Park near San Jose, and will pass through Redwood City, Menlo Park, Palo Alto, Mayfield, Mountain View, Sunnyvale, Santa Clara and San Jose. The total length will be about forty miles. The capital stock of the company is $5,000,000, of which $50,000 has been subscribed. The directors are: J. C. Campbell, E. M. Rea and W. H. Metson, of San Francisco, and J. F. Parkinson and Frank D. Dorman, of Palo Alto.

NEW ROCHELLE, N. Y.—The New Rochelle common council and the board of village trustees of Larchmont have decided to

allow the New York, New Haven & Hartford Railroad to widen its roadbed to accommodate eight tracks and to operate a trolley line between New Rochelle and Larchmont, completing the company's trolley circuit from the Harlem river to Boston. The company owns all trolley lines that run parallel to its own line from Larchmont to Boston. The officials have been figuring how they could connect their Larchmont, Greenwich & Stamford line with the proposed six-track electric service from New Rochelle to the Harlem river, in course of construction. This stretch of road, about three miles long, is monopolized on the Boston road, which is the direct route, by the Union Railway Company. The two new trolley tracks will run directly alongside the New Haven's present rails, and are expected to be ready for use in the spring. Heavy cars for the new service from the New Rochelle station to Stamford, Ct., are being built.

PERSONAL MENTION.

MR. EDGAR S. FASSETT, general manager of the lines of the United Traction Company, Albany, N. Y., has been made general manager also of the Hudson Valley Railway, which has passed under the control of the United company.

MR. C. E. F. AHLM, of Cleveland, Ohio, has been appointed consulting engineer for the illumination of the new factory of the Garford Company, at Elyria, Ohio. This factory contains a total floor space of 102,000 square feet, and will be used for the manufacture of automobiles and automobile parts.

MR. BION J. ARNOLD, the well-known consulting engineer, addressed the Pike's Peak Polytechnic Society, Colorado Springs, Col., at its annual dinner on December 28. Mr. Arnold took for his subject "Electric Traction in New York and Chicago," and delivered a very instructive and entertaining talk on the conditions existing in the two cities.

MR. E. H. MATHER has severed his connection as treasurer and manager of the Portland (Me.) Lighting and Power Company, and will hereafter be located in Boston, Mass. Mr. George E. Raymond, of the Consolidated Electric Light Company, has been elected treasurer of the Portland company, and Mr. James A. Fleet has been made general superintendent.

MR. W. K. BOARDMAN, who for the past two years has been superintendent of the East Tennessee Telephone Company, has been made manager of the Memphis (Tenn.) exchange of the Cumberland Telephone and Telegraph Company, succeeding Mr. T. M. Derrickson. Mr. L. K. Webb, who has been manager of the Chattanooga (Tenn.) exchange of the East Tennessee company, has been made superintendent of the company, with headquarters at Knoxville, Tenn. Mr. C. H. Stair, manager of the Owensboro (Ky.) exchange, goes to Chattanooga as manager of the exchange there.

MR. WILLIAM J. CLARK, of New York city, has been appointed by Governor Hughes a delegate from New York state to the national convention for the extension of the foreign commerce of the United States, which will be held at Washington, D. C., beginning Monday, January 14. Mr. Clark is general manager of the foreign department of the General Electric Company. He has studied the conditions of foreign commerce for many years, and his book, "Commercial Cuba," is recognized as an authority on the subject. Mr. Clark has been a delegate to many important commercial conventions, and in 1905 was a member of the United States delegation at the International Railroad Congress held at Washington.

MR. FRANK A. PERRET, of Brooklyn, N. Y., upon the proposal of the Duke of Aosta, under the recommendation of Professor Matteucci, of the Mount Vesuvius Observatory, and the request of Minister of Foreign Affairs Tittoni, has had conferred upon him by King Victor Emmanuel III the Cross of Cavaliere Ufficiale of the Crown of Italy for his conduct and services in the cause of humanity and science during the great eruption of Vesuvius last April. Mr. Perret was nominated by the University of Naples in 1905 as honorary assistant of the Royal Vesuvius Observatory, and with Professor Matteucci and two others remained at his post throughout the terrific eruption of the past year, making invaluable observations and photographs. This is a special honor, as the title is rarely conferred upon one who has not already been decorated as simple Cavaliere.

ELECTRICAL SECURITIES.

Following a somewhat apathetic condition of the stock market during the early days of the week there was a general rally in business, for which the growing ease in the money market was held largely responsible. The situation was also improved by marked activity in copper shares and the prospect of enlarged dividends upon Amalgamated. Call loans were made on Monday at 45 per cent, the rate dropping on Friday to 6 per cent. The week's receipts on balance from the interior are in nearly all cases the heaviest since the outflow of funds began with the crop-moving season. The yearly record of business failures shows a total of 10,682 failures, against 11,520 in 1905, and with liabilities of $119,200,000, against $102,600,000. Industrial conditions are considered very favorable, with indications of great expansion during the coming months.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 5.

New York:	*Closing.*
Allis-Chalmers common	16⅞
Allis-Chalmers preferred	42¾
Brooklyn Rapid Transit	80⅜
Consolidated Gas	138¼
General Electric	160⅛
Interborough-Metropolitan common	36⅛
Interborough-Metropolitan preferred	73¾
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	69¾
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	142½
Metropolitan Street Railway	105
New York & New Jersey Telephone	113
Western Union	83⅛
Westinghouse Manufacturing Company	154

Boston:	*Closing.*
American Telephone and Telegraph	132½
Edison Electric Illuminating	225
Massachusetts Electric	68½
New England Telephone	125
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	68
Electric Storage Battery preferred	68
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	22¼
United Gas Improvement	95¾

Chicago:	*Closing.*
Chicago Telephone	115½
Chicago Edison Light	144
Metropolitan Elevated preferred	69½
National Carbon common	85
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

The Metropolitan Elevated December daily average of fares was 155,790, an increase of 19,001.

The daily average of fares received by the South Side Elevated during the month of December was 95,213, a decrease of 2,285.

The daily average number of passengers carried on the Northwestern Elevated for December was 94,904, an increase of 7,705.

NEW MANUFACTURING COMPANIES.

NEW YORK, N. Y.—The Motor Sales Company has been incorporated with a capital of $25,000 by F. A. Russ, S. J. Leonard, of Greenwich, Ct., and E. Dreggins, of New York city, to manufacture gas and electrical machinery.

JERSEY CITY, N. J.—John Platt & Company have been incorporated to manufacture dynamos and electrical apparatus. The capital stock is $25,000, and the incorporators are: H. O. Coughlan, B. Trafford Mantz and John R. Turner.

NEW INCORPORATIONS.

NEW ORLEANS, LA.—Lake Charles Ice, Light and Waterworks. Increased from $100,000 to $150,000.

INDIANAPOLIS, IND.—Farmers' Metropolitan Telephone Company, Palmyra, Harrison county. $500. Directors not chosen.

LENA, ILL.—Lena Electric Light and Power Company, Lena. $12,000. Incorporators: G. W. Benfer, J. D. Hinds and A. J. Clarity.

CLAYTON, ILL.—Clayton Farmers' Mutual Telephone Company, Clayton. Incorporators: Daily C. Lewis, Robert L. Bauton and William Meatheringham.

SOUTH BOSTON, VA.—Washington-Connecticut Company. To operate light and power plants. $100,000. President, W. D. Hill; secretary-treasurer, R. Holt Easley.

ASHEVILLE, N. C.—Asheville Rapid Transit Company. $500,000. Incorporators: Charles E. Van Bibber, Holden, Mass.; Thomas S. Rollins and John P. Authur, Asheville.

RUSHVILLE, ILL.—Rushville, Pleasant View & Browning Mutual Telephone Company, Rushville. $1,250. Incorporators: M. S. Strong, William R. Lawler and M. W. Greer.

GUTHRIE, OKLA.—The Hoebling Telephone Company, of Okarche. $6,000. Directors: T. F. Hausem and J. W. Thiems, of Calumet; John Hoebling, M. Weivel, G. D. Lovell, H. Frederick and C. Theims, of Okarche.

YORK, PA.—Hanover & York Street Railway. $120,000. Directors: George H. Frazier, Philadelphia; Grier Hersh, York; David Young, Newark, N. J.; Thomas Newhall, Philadelphia; A. H. Heyward and George S. Schmidt, York.

ALBANY, N. Y.—The Salem Light, Heat and Power Company, of Salem, Washington county. $50,000. Directors: John F. O'Brien, Plattsburg; W. A. Reynolds and M. A. White, Whallonsburg, Essex county, and Jarvis P. O'Brien, of Troy, N. Y.

TELEPHONE AND TELEGRAPH.

DUBUQUE, IOWA—The Dubuque Telephone Company will extend lines to the neighboring towns in Wisconsin.

SHUTESBURY, MASS.—The New England Telephone Company is extending its line from Cushman to East Leverett.

ALBERTA, CANADA—Alberta will construct a public telephone line reaching all points between Edmonton and Lloydminster.

CEDAR RAPIDS, IOWA—The Cedar Rapids & Marion Telephone Company will rebuild the local exchange at a cost of about $40,000.

JACKSONVILLE, FLA.—The Postal Telegraph-Cable Company has completed its line from Jacksonville to Sanford, *en route* to Tampa.

NEW BEDFORD, MASS.—The Automatic Telephone Company, of this city, has been granted permission by the commissioner of corporations to increase its capital stock to $50,000.

MONMOUTH, ME.—The Lewiston, Greene & Monmouth Telephone Company has recently purchased of the New England Telephone Company the instruments and rights of that company in the town of Winthrop, for something over $2,000.

DES MOINES, IOWA—The Mutual Telephone Company has bought a lot on which it will erect a thoroughly modern two-story fireproof exchange building. This is to be a branch office. In it will be installed a central-energy switchboard having a capacity of 3,000 lines.

AKRON, OHIO—Improvements costing $30,000 are to be made by the Central Union Telephone Company within the next two months. The company has been given permission by the service board to string new wires and cables and set new poles in all parts of the city.

OMAHA, NEB.—It is announced that the Omaha Independent Telephone Company will erect a central exchange near the business centre of Omaha at a cost of $200,000, and three subexchanges ranging in cost from $30,000 to $50,000. Active work on the system has been postponed until spring.

BENTON HARBOR, MICH.—The city council has granted a franchise to the Lake Shore Telephone Company, of Benton Harbor, to put in a telephone system in Benton Harbor. The Stromberg-Carlson Telephone Company is back of the Lake Shore company, represented by S. W. Menefee, Carl Schaefer and J. P. Cracraft, of Detroit.

READING, PA.—The Kutztown Rural Telephone and Telegraph Company and the Kempton rural division of the Pennsylvania Telephone Company are each building a line from Kempton to Trexler, Wanamaker, Jacksonville and places further north. The Kutztown company will also extend the line through Kutztown and install a number of telephones in private and business houses.

WASHINGTON, PA.—An application will be made to the governor of the state for a charter for a corporation to be known as the State Mutual Telephone and Telegraph Company. This company declares that it is the purpose of the organization to operate in Washington, Greene, Fayette, Somerset, Westmoreland, Indiana, Armstrong, Butler, Lawrence, Beaver and Allegheny counties.

CLARKSVILLE, TENN.—At a meeting of the city council an ordinance was passed on final reading requiring all wires in the fire district, with the exception of trolley wires, to be placed underground by next September. The Home Telephone Company has its wires underground, but the Cumberland Telephone Company has not. The change will necessitate the expenditure of thousands of dollars.

SYRACUSE, N. Y.—A certificate of merger of the Franklin Telephone and Telegraph Company with the Hudson River Telephone Company has been filed at Albany. Vice-President H. F. Stevens, of the Hudson River company, who lives in Syracuse, said that the Hudson River company had controlled the Franklin company for several years and the merger was merely a formality. The Franklin company serves the vicinity of Saranac Lake.

LAFAYETTE, IND.—The Lafayette Telephone Company has awarded a $65,000 contract for a new switchboard and complete telephone system to the Sterling Electric Company, of Lafayette. The company recently awarded a $15,000 contract for underground conduits. To cover the expense of the improvements, $150,000 worth of preferred stock has been issued. The installation of the new system will be begun as soon as the Sterling company can turn out the equipment.

ALLENTOWN, PA.—The American Union Telephone Company, a consolidation of nearly all of the independent telephone companies in Pennsylvania, southern New York, Maryland, Virginia and West Virginia, has been permanently organized. Ellis Orvis, of Bellefonte, was elected president; B. F. Meyers, of Harrisburg, vice-president; S. R. Caldwell, secretary and treasurer; Lyman D. Gilbert, general solicitor; Colonel C. M. Clement, Sunbury, assistant solicitor; George W. F. Reily, member of the executive committee for Harrisburg. F. D. Houck, of Harrisburg, was elected general manager.

BURLINGTON, VT.—Plans are being drafted by the New England Telephone and Telegraph Company for the laying of a submarine cable across Lake Champlain next season. The route of the line, which is designed to connect Burlington with Plattsburgh, N. Y., will be north from Burlington through the islands to a point nearly opposite Plattsburgh and thence across the lake. The new building being erected by the company was to be ready for occupancy by the division offices January 1, and the exchange will be transferred early in the spring. Large additions to the Burlington service will be made then, when the common-battery system will be installed.

RALEIGH, N. C.—A franchise has been granted by the Raleigh board of aldermen for the Capital City Telephone Company, which will take over the local exchanges of the Southern Bell and the Interstate companies, the Bell having the controlling interests in the new company. This will leave Raleigh with two instead of three separate telephone systems, the Raleigh remaining in the field as an independent company. The new company will install an entirely new plant in a building of its own, to cost $20,000. The franchise fixes the rates at $2.50 per month for business and $1.50 for residence telephones, until the exchange has more than 1,000 subscribers; then graduated increases in charge are provided for.

ELECTRIC LIGHTING.

SALEM, ILL.—A new 3,000-light dynamo has been installed in the city light and power plant.

YORK, PA.—The Merchants' Electric Light Company has placed in operation two 500-horse-power boilers.

ALBANY, N. Y.—The state commission of gas and electricity has authorized the Poughkeepsie Light, Heat and Power Company, of Poughkeepsie, to issue $150,000 of convertible debenture bonds.

GIRARDVILLE, PA.—The contract for lighting the streets of Girardville has been awarded to the Frackville & Gilberton Light, Heat and Power Company at $70 per arc light, the price fixed by last year's council.

SANDY HILL, N. Y.—The United Gas, Electric Light and Fuel Company has sold to the Glens Falls Gas and Electric Light Company its rights, property and good-will to operate in Sandy Hill, Fort Edward and South Glens Falls.

PALMER, MASS.—The officers elected at the meeting of the Central Massachusetts Electric Light Company are as follows: treasurer, Charles B. Fiske; clerk, F. N. Carpenter; directors, M. J. Warner, A. W. Paige, H. L. Merry, Edward Fairbanks, George E. Fuller, George C. Flynt, Charles B. Fiske, W. H. Fairbanks and Charles E. Fish.

WASHINGTON, D. C.—The secretary of the interior has granted authority to the reclamation service to construct by force account a canal approximately three miles in length, to be used in connection with the power plant to be constructed for the generation of electricity at the mouth of Spanish Fork river, Strawberry Valley irrigation project, in Utah.

ALEXANDRIA, VA.—The Alexandria Electric Company has placed on record a deed of mortgage to secure to the Baltimore Trust and Guarantee Company the sum of $150,000. The Alexandria Electric Company is the corporation which recently came into possession of the city lighting franchise, and the sum stated is to be used in the erection of its new plant.

PONTIAC, MICH.—The council has ordered the city attorney to take action to annul the contract of the Pontiac Standard Lighting Company. The contract calls for commercial electric lighting in addition to street lighting, but the commercial part of the contract has not been lived up to. The company says the contract must be modified before it can enter the commercial field.

LOUISVILLE, KY.—Articles of incorporation for the White City Electric Light, Heat and Power Company have been filed. The capital stock is $300,000, divided into shares of $100. The incorporators are: Richard D. Bakrow, C. C. McClarty, John M. Sharp. The maximum debt is $300,000. The company will furnish light, heat and power for the "White City," an amusement enterprise now in course of construction at Riverview.

BAYONNE, N. J.—To the Public Service Corporation the Bayonne common council has awarded a five-year contract to furnish the city with gas and electric street lights. Under the contract the city will save nearly $500 a month on lighting alone. The Public Service Corporation agrees to provide electric lights at the rate of $85 a light of 2,000 candle-power, a year, providing there are not less than 250 lights; and if the number of lights is increased to 350, the price will be $80 a year per light. At the present time the city is paying at the rate of $100 a year for each arc light on the streets.

LYNCHBURG, VA.—The board of aldermen defeated the project looking to the establishment of a municipal electric light plant in the pump-house when the gravity water system shall have been installed. A special committee, after investigating the causes of the present inefficient street lights, recommended that the council make provision for a ten-year contract with the local traction company on a basis of 300 lights at fifteen cents each a night. The company has agreed to such a contract and to a proviso that the city, after a term of years, can become the owner of the lighting branch of the company. This report was adopted by a unanimous vote and in effect kills the municipal project, on which bids have already been received.

INDUSTRIAL ITEMS.

THE OTTO GAS ENGINE WORKS, New York city, announces its removal to 136 Liberty street.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., has ready for distribution a handsome booklet devoted to "P. & S." brass sockets. This booklet will be sent to any one interested upon request.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has opened a permanent office at room 1525, First National Bank Building, Chicago, Ill., where it will take care of its western automobile battery works and western train-lighting work.

THE GEORGE WEIDERMAN ELECTRICAL COMPANY, INCORPORATED, 21-27 New Chambers street, New York city, is distributing a very pretty calendar. This includes a small calendar pad attached to a large beveled mat which is embellished with a lithograph in colors.

W. H. SCHOTT, Chicago, Ill., inventor of the Schott systems of heating and steam distribution, is remembering his friends with a beautiful Christmas souvenir. This takes the shape of a lithograph in color, the principal figure being set out in relief. The subject is entitled "The Signal," and is the work of John Paulding, sculptor.

THE AJAX LINE MATERIAL COMPANY, 12 and 14 South Jefferson street, Chicago, Ill., has appointed the Kilbourne & Clark Company, of Seattle, Wash., as its northern Pacific agent. The latter company will add to its present stock an assortment of Ajax mast arms, arc lamp pulleys, arc insulators, toggle bolts and incandescent street hoods.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., recently made an elaborate exhibit of its apparatus at the New York Academy of Sciences, in conjunction with the meeting of the American Association for the Advancement of Science. This exhibit includes an alternating-current-direct-current comparator, a new optical device for sensitive deflection instruments, a synchronized alternator, a motor secohmmeter, and a portable telescope galvanometer.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently issued a folder describing the application of chloride accumulators and Exide batteries to railway signal and interlocking systems. The folder contains an interesting table, showing the rapid progress in the use of these batteries for this class of work and gives illustrations of several types usually employed in signal service. Illustrations are also shown of batteries of chloride accumulators in place in semaphore towers.

THE GERMANIA ELECTRIC LAMP COMPANY, Newark, N. J., is occupying its new factory at Newark, where double the facilities of its old equipment at Harrison, N. J., are available. A short time ago the old plant, which had been occupied by the Germania company at Harrison, was burned down. This, it is understood, gave rise to an erroneous impression that the company had suffered through the fire. Announcement is made, however, that there was no part of the Germania company's equipment in the building at the time.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., maker of wire rope and wire for all purposes, is distributing a very useful calendar. The calendar pad is of large size, and the figures are of such dimensions that they may be easily read across a large room. An illustration of the upper works of the company at Trenton gives a very good idea of the immensity of this establishment. The company is also distributing to its friends and patrons, as a New Year remembrance, a beautiful lithograph bearing the New Year's greeting from Poor Richard's Almanac.

THE F. D. LAWRENCE ELECTRIC COMPANY, Cincinnati, Ohio, is sending to some of its friends one of the handsomest calendars which has been distributed this year. The subject of the illustration is entitled "Christmas Greetings," by Arthur. What makes this calendar particularly attractive is the generous spirit with which the company has refrained from placing any advertising on the face of the mat, simply making a modest announcement on the reverse side of the calendar. The company will send this calendar to any one for fifty cents in stamps.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., an-

nounces that a National Battery depot has been opened in Chicago, located at 271 Michigan avenue. The depot is in charge of George S. Berger, who has been associated with the storage battery business in Chicago for many years. A complete stock of electric vehicle and sparking battery parts will be carried, so that prompt renewals and repairs can be made of any standard-sized battery, as well as any National battery. The National Battery Company's sales office at 450 Old Colony Building, Chicago, will be, as heretofore, under the management of Bertram Smith.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces the following recent sales: National Tube Company, McKeesport, Pa., one 340-horse-power, 230-volt, direct-current motor; four 125-horse-power, 230-volt, direct-current motors for driving pumps, and six fifteen-horse-power, 230-volt motors. American Printing Company, Fall River, Mass., one seventy-five-horse-power, 230-volt, direct-current motor. American Wood Working Machinery Company, Rochester, N. Y., two thirty-two-horse-power, 230-volt, direct-current motors, one thirteen-horse-power, 230-volt, and one ten-horse-power, 230-volt, direct-current motors. International Silver Company, Bridgeport, Ct., eleven direct-current motors aggregating 162 horse-power. The Balance Cable Company has recently placed orders with the company, through the Mallard Construction Company, of Jersey City, N. J., for six forty-horse-power crane motors. The Isbell Porter Company, Newark, N. J., has also ordered one thirty-five-kilowatt, 250-volt, direct-current generator and one twelve-horse-power, two six-horse-power and one five-horse-power, direct-current motors for driving ice machines. The Williams Construction Company, Corinth, Miss., has placed orders for the following machinery: one 300-kilowatt, engine-type, alternating-current generator; one 200-kilowatt, 600-volt, engine-type, direct-current generator; one 100-kilowatt direct-current generator; two 100-kilowatt, three-phase transformers; one 300-horse-power, 2,300-volt induction motor; one 150-horse-power, 550-volt induction motor. This equipment is to furnish power for the Corinth & Shiloh Electric Railway.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 39 South Tenth street, Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York city. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, London, Canada.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Ernest H. Davis, Williamsport, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meeting held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January 24, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliott, 4 Irving place, New York city. Meetings in New York city, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

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IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. W. Chambers, Winchester, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis. Next annual meeting, Chicago, January 16-18.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Milwaukee, Wis., October 14, 1907.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, Chicago.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Chicago, Ill., January 16, 17 and 18, 1907.

Ohio Engineering Society. Columbus, Ohio, January 22-24, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Record of Electrical Patents.

Week of January 1.

839,815. MANUFACTURE OF ELEMENTS FOR BATTERIES OR ELECTROLYTIC APPARATUS. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. The separator is made up of parts baked together and split apart.

839,816. ELECTROCHEMICAL APPARATUS. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. The fluid-container has an increasing cross-section at increasing depths.

839,817. COUPLING FOR BATTERY ELEMENTS. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. The parts are held in close contact by the weight of the plate.

839,830. TELEPHONE HOOK-SWITCH. George D. Foster, Chicago, Ill., assignor to American Electric Telephone Company, Chicago, Ill. A removable hook.

839,869. ELECTRIC LAMP. Frederick Muschenheim, New York, N. Y. A holder and reflector for an incandescent lamp.

839,910. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A modified common battery system.

839,928. ELECTRIC HEATING ATTACHMENT FOR HOT-WATER BAGS. Charles Van Dyke Hill, St. Louis, Mo. A heating element is inserted in place of the usual stopper.

839,935. PHASE-ADJUSTING MEANS FOR ALTERNATING-CURRENT MOTORS. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A variable voltage transformer is inserted across one phase of the system.

839,936. PHASE-ADJUSTING APPARATUS. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Electromotive forces of different phase are supplied to the field-magnet circuit.

839,937. METHOD OF REGULATING THE SPEED OF ELECTRIC MOTORS. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The electromotive force at the field-winding terminals is varied by varying the impedance of the circuit.

839,958. REGULATOR FOR ALTERNATING-CURRENT MOTORS. Clarence Renshaw, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Campany. The motor armature is supplied from a variable voltage transformer.

839,983. ELECTRIC FURNACE. William H. Bristol, New York, N. Y. The heating element is enclosed within a fused quartz receptacle.

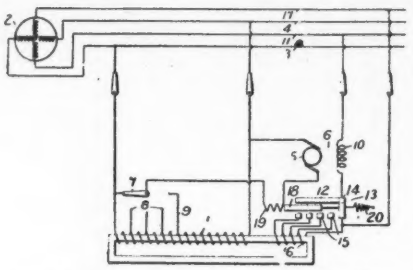
839,984. THERMOELECTRIC GENERATOR. William H. Bristol, New York, N. Y. Two elements of differing fusing points are employed.

839,985. THERMOELECTRIC GENERATOR. William H. Bristol, New York, N. Y. Two sets of elements are used, the hot junction of one being placed adjacent to the cold junction of the other.

840,001. METHOD OF REGULATING ALTERNATING-CURRENT MOTORS. Benjamin G. Lamme, Pittsburg, and Clarence Renshaw, Wilkinsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company. The phase relations of the applied electromotive forces are varied in accordance with the amount of current traversing one of the circuits.

840,002. DUPLEX TELEGRAPH. Joseph W. Larish, New York, N. Y., assignor of one-half to Postal Telegraph-Cable Company, New York, N. Y. A system for branch lines.

840,005. TESTING DEVICE. Asa M. Mattice, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. An electrical gauge for measuring the amount of bearing wear.



839,935.—Phase-Adjusting Means for Alternating Current Motors.

840,009. APPARATUS FOR ERECTING AERIAL CABLES. Ralph S. Peirce, Chicago, Ill. A hook formed from a bent metal plate.

840,013. CONTROLLING ELECTRIC POWER DISTRIBUTING SYSTEMS. Joseph L. Routin, Lyons, France. The controller is an electric motor with a compound-wound field.

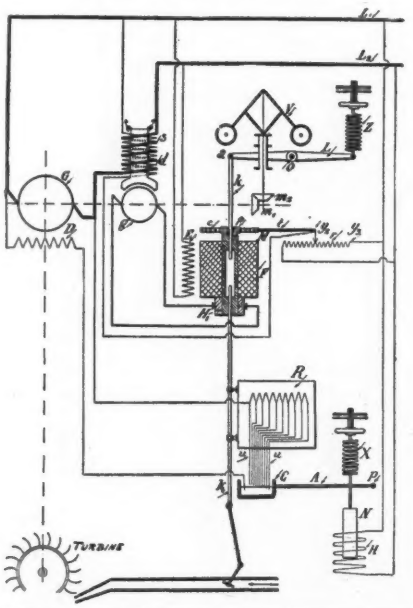
840,014. ELECTRICAL PLUG RECEPTACLE. Frank J. Russell, New York, N. Y. A countersunk receptacle.

840,018. APPARATUS FOR SEARCHING OF SUNKEN BODIES. Max von Schoultz, St. Petersburg, Russia. A magnetic sounding device.

840,028. LIGHTNING ARRESTER. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Company. A multiple gap arrester.

840,036. LIGHTNING ARRESTER CONNECTION. Edward A. Baldwin, Schenectady, N. Y., assignor to General Electric Company. A compound delta-Y connection.

840,051. TAPE-PUNCHING REGISTER. John L. Du Frane, Oakland, Cal. A combined punch and register.



840,013.—Controlling Electric Power Distributing Systems.

840,060. HEATING ATTACHMENT FOR HOT-WATER BAGS. Charles Van Dyke Hill, St. Louis, Mo. The heater, inserted into the bag, is surrounded by a perforated tube.

840,066. CONDUIT. Louis A. Jones, Cambridge, Mass., assignor to American Circular Loom Company, Chelsea, Mass. A conduit of laced flat strips of resilient material.

840,068. PANELBOARD FOR ELECTRICAL DISTRIBUTION. Edward N. Lake, Chicago, Ill. A method of wiring.

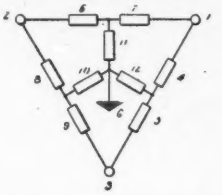
840,069. TELEPHONE TRANSMITTER. Alfred Larsden, Buffalo, N. Y. A resilient ring, with enlarged periphery, rests against the diaphragm.

840,087. CONTACT SHOE FOR ELECTRIC RAILWAYS. Henry C. Pealow, Batavia, Ill. A pair of shoes pressed against the top and sides of the rail.

840,120. ELECTRICAL TYPEWRITER SELECTING AND OPERATING MEANS. George W. Donning, East Orange, N. J., assignor to Harry T. Ambrose, Orange, N. J. A common power bar and selective devices operate the type bars.

840,121. ELECTRICAL TYPEWRITER. George W. Donning, East Orange, N. J., assignor to Harry T. Ambrose, Orange, N. J. A method of utilizing a common power bar.

840,129. HOISTING MACHINE. Arthur E. Handy, Providence, R. I., assignor to Rhode Island Elevator and Machine Company, Providence, R. I. An electrically driven hoist.



840,036.—Lightning Arrester Connection.

840,135. SIGNAL APPARATUS. W. Britton Lane, Evanston, Ill. An electrical block signal system.

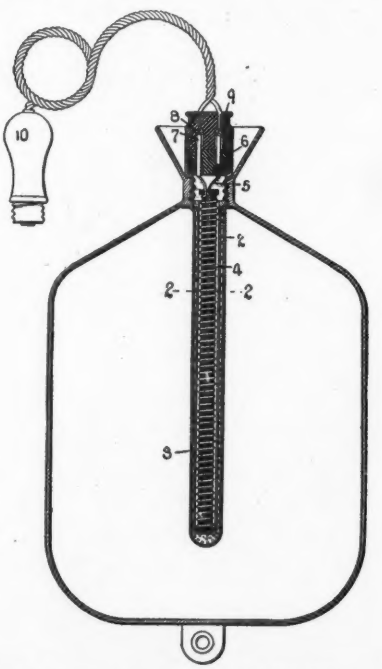
840,150. TRANSFORMER. Walter S. Moody, Schenectady, N. Y., assignor to General Electric Company. A method of arranging the coils.

840,159. ELECTRICAL SIGNALING APPARATUS. John D. Peachey, East Orange, N. J. An indicating drop for fire-alarm or police-signal systems.

840,182. PENDENT SWITCH. Herbert C. Wirt, Schenectady, N. Y., assignor to General Electric Company. Design for a key-switch.

840,186. MOTOR-STARTING RHEOSTAT. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. An auxiliary circuit is closed around the controller arm.

840,201. ELECTROMAGNET SIGNAL. Henry M. Crane, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. An annunciator drop.



840,060.—Heating Attachment for Hot-Water Bags.

840,216. SYSTEM OF ELECTRICAL DISTRIBUTION. Rudolf Hundhausen, Wilmersdorf, near Berlin, Germany, assignor, by mesne assignments, to General Electric Company. A means for maintaining the proper polarity in a single branch circuit from a three-wire system.

840,336. INSULATOR. Alfred Johnson, Quincy, Ill. A compound insulator.

840,344. ELEVATOR GATE-CLOSING MEANS. Charles W. Kirsch, Chicago, Ill. An electrically controlled elevator door.

840,451. COMMUTATOR. Manes E. Fuld, Baltimore, Md. A method of constructing a commutator of few parts.